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JOHN TATLOCK.

By GEORGE C. COMSTOCK.

John Tatlock, for many years a conspicuous figure at meetings of the American Astronomical Society, died at Brookline, Mass., on January 3, 1926. Quick of wit, with a keen sense of humor and with a lifelong interest in astronomy, he was a picturesque and interesting as well as a loveable character, whose loss will be keenly felt by many American astronomers. They will join in the words of the young reporter at the recent Northfield meeting whose inquiries he parried with the phrase, I am only an amateur, to which there came the prompt response "You are the man who interests me. These other gentlemen are professionals who come here as a matter of business, you come because you love it."

Mr. Tatlock's interesting and successful career may be briefly summarized as follows: Born in 1860, at Williamstown, Mass., the son of a clergyman of English origin, he was educated in Williams College where he came under the dominating influence of Professor T. H. Safford and learned from him the significance of meridian work for the advancement of astronomy. Graduating from Williams in 1882 he came a little later to the Washburn Observatory where, under Holden, he took part in the meridian circle observations then in progress. The following year was spent at Beloit College, in charge of its observatory, and, after the fashion of the time, largely occupied in teaching elementary mathematics. The task proved uncongenial and he soon severed his connection with Beloit and, to his keen regret, found the avenues leading to an astronomical career apparently closed to him or, at least, too slow of access for him to pursue them further.

Returning east he entered the service of one of the large life insurance companies and there found speedy advancement along the scientific side of its business. As its Associate Actuary he came to take a prominent part in the Actuarial Society of America and was for a considerable period charged by his company with general care of its European interests, spending much time abroad in direct negotiation with governmental bureaux of Russia, Austria and Germany. In 1904 he became president of the Washington Life Insurance Company of New York, and was for several years engaged in rehabilitating its tangled affairs. This work was, perhaps, too successful, for the run-down company became a worth while acquisition for new interests who thought their ends best served by a change of administration.

Retiring from the company and from the insurance business, Mr.

Tatlock organized and became president of a bank in the Bronx which, flourishing under his administration, was subsequently merged with one of the larger banks of New York City. Nominally this merger marked the close of Mr. Tatlock's business career but up to the very end of life his services were in constant demand for fiduciary purposes, in which he freely served a wide range of friends, including the Astronomical Society. During this period a prominent American university sought, but without success, to secure his services as its Business Manager.

Early in his career Tatlock identified himself with the New York Academy of Sciences and continuously maintained an active interest in its affairs that culminated in election to its presidency, a relation that subsisted up to the time of his decease.

In 1886 Mr. Tatlock was married to Miss Kate Chamberlin and to them was born one child, a son, who died in infancy. Mrs. Tatlock remains as the sole surviving member of his immediate family and to her there flow freely the sympathy and good will of his many astronomer friends.

ON THE APPEARANCE OF THE COMETS IN 1925 FROM OBSERVATIONS AT THE YERKES OBSERVATORY.

By G. VAN BIESBROECK.

During the year 1925 a record number of comets have been visible. It is true that none of them developed a spectacular appearance nor lent itself to a thorough physical study. Several were so faint that even at their brightest they could be seen only with large telescopes. Yet others presented in their physical appearance interesting features that are worth recording.

The year opened with only one comet under observation, an extremely faint little nebulosity discovered by M. Wolf at Heidelberg (Germany) at the end of 1924. It was followed only during a month but this was enough to show that the path described was an ellipse corresponding to a period of some eight years. The object was observed only photographically; the measures are few and uncertain since the light of the comet was not brighter than that of a 16^{M} star.

The series of newly discovered objects opens in March with two unexpected comets found at two days' interval. The curious circumstances of the discovery of G. Shajn's comet 1925*a* on March 22 at Simeis (Crimea) have been told in *P. A.*, Vol. 33, p. 337. When first seen with the 40-inch refractor the comet appeared to me as a round nebulosity, about 90″ in diameter with a 13^{M} stellar nucleus. The total brightness was estimated 11^{M} at the end of March. In Fig. 1, reproduced from a 30-minute exposure, that I secured with the 24-inch reflector on March 26, we further notice that the nebulosity surround-

ing the nucleus is somewhat unsymmetrical and extends mostly in a southwest direction (position angle 240°); this extension could however hardly be called a tail. The object declined in brightness owing to its increasing distance. In June it was lost in the glare of the sun but was again observed in December with little change from its earlier appearance.

The orbit of this comet is exceptional in that at the time of the nearest approach to the sun, which occurred in September, its distance from the central body of our system was over four astronomical units, a figure which is larger than for any other comet known to this date. While slowly receding from both earth and sun this distant visitor will presumably be followed for several months yet in 1926.

The first dispatches about comet Shajn were still being exchanged when another comet was announced, this time from the southern hemisphere. It was picked up at Newlands near Capetown by W. Reid, an enthusiastic amateur, whose name has been mentioned frequently in recent years for similar discoveries. The comet was of about eighth magnitude and was recorded with the 40-inch refractor as a nebulosity of some 5′ diameter, the light of which gradually increased towards a central, almost star-like nucleus. The nebulosity extended mostly in a northwest direction. Fig. 2 is a reproduction of a 40-minute exposure with the 24-inch reflector obtained by O. Struve on March 28. The nebulosity shows here a broad extension in position angle 310°, making a coarse tail 15′ long. During the exposure a swift meteor crossing the field left a faint trail passing quite close to the head of the comet. The arrow shows the direction of the flight.

While the comet moved farther south its brightness increased and it became visible to the naked eye for observers in the southern hemisphere. Northern observers lost sight of it in May; but in January, 1926, six months after its nearest approach to the sun (July, 1925) the comet had moved sufficiently to the north to be again observable here. I recorded it then as a round diffuse nebulosity 15″ in diameter with hardly any central condensation. Its brightness was estimated 12^{M} on January 12. It is not impossible that later in the year, after its conjunction with the sun, the object may be followed with powerful instruments. This would be very desirable in order to confirm the period of 14 years indicated by preliminary computations for the returns of this comet.

The third new comet of the year, 1925*c*, was discovered by L. Orkisz at Mount Lysin, a temporary station near Cracow (Poland). On April 18 I estimated its brightness as 8^{M}. It had a sharp stellar nucleus surrounded by a nebulosity about 5′ in diameter, which extended mostly in a direction opposite to the sun. Moving rapidly to the north the comet was then near its greatest brilliancy; it had passed nearest to the sun shortly before its discovery. Fig. 3 shows the appearance on April 23, from a plate that I exposed 15 minutes with the 24-inch reflector. The dissymmetry of the nebulosity around the nucleus is quite notice-

able, but the plates reveal furthermore the existence of a broad tail, which can be followed on the original to about 12′ from the nucleus in position angle 285°. Visual observations did not disclose this tail at all. From an examination of the spectrum with the 6-inch UV prism-camera, N. Bobrovnikoff finds that almost all the radiation is concentrated in two bands: one at λ 3883 due to cyanogen and one at λ 4693 of carbon monoxide. The continuous spectrum due to the reflected sunlight also showed quite distinctly (*P. A.*, Vol. 33, p. 417). This comet came within 8° of the pole on June 1, and was still of about 9^{M} at that time, but then it gradually became fainter. I observed it again in November and December as a 14th magnitude small nebulosity, only 20″ in diameter, and expect to follow it for several months yet before it is too faint for our instruments.

Next in order of discovery comes an exceptional series of five periodic comets. For all of these good search ephemerides were available so that it would be better to call these recoveries rather than discoveries. The first of these is comet Temple II 1925*d* found photographically by J. Stobbe at Bergedorf (Germany) on June 11. When first seen here on June 18, I estimated the brightness as 11^{M} and noted that most of the light was concentrated in a sharp nucleus out of which emanated a broad fan-shaped tail some 3′ long in position angle 290°. In the opposite direction there was no nebulosity to speak of, so that the nucleus was situated very eccentrically on the following side of the body. Fig. 4 reproduced from a plate that I exposed July 23 with the 24-inch reflector shows this characteristic shape. On July 15 I estimated the tail as 20′ long. The spectrum was investigated about that time by N. Bobrovnikoff with the 6-inch prism-camera; it showed little reflected sunlight but three strong emissions, one corresponding to the cyanogen band at λ 3883 and two others due to carbon monoxide (*P. A.*, Vol. 33, p. 638). The comet reached a maximum brightness of 8^{M} about the time of its perihelion passage August 7. After that date its brightness fell off rapidly and northern observers soon lost sight of it on account of its southerly position. Toward the end of the year I saw it again on a couple of nights; on December 13, I estimated the brightness as 16^{M}. It appeared then as a round diffuse nebulosity some 15″ in diameter, which was not seen after that date.

The next periodic comet 1925*e* (Wolf) was picked up by photography at Bergedorf, by W. Baade on July 13, almost exactly in the place predicted by Kamiensky, director of the Warsaw Observatory. On July 18, I recorded it as an inconspicuous small nebulosity, only 10″ in diameter, and not brighter than 15^{M}. It stayed so through the summer months brightening up to $14^{M}.5$ in August. On August 22 the nucleus itself was about 5″ in diameter and situated on the following side of the nebulosity, which extended to 25″ in direction 270°. In November the comet was much fainter and at the limit of visibility for the 40-inch refractor. With the 24-inch reflector a last exposure was obtained by Mr. Struve on December 19; the brightness was then estimated as 17^{M}.

PLATE VII.

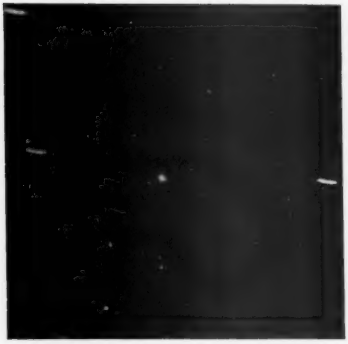

FIG. 1.
Comet Shajn, 1925 March 26.16 U. T.

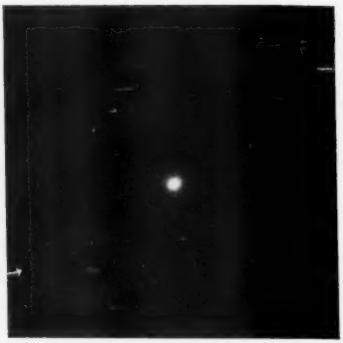

FIG. 2.
Comet Reid, 1925 March 28.29 U. T.

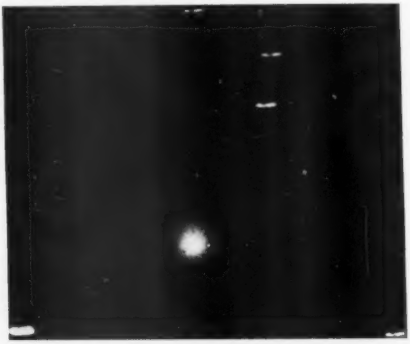

FIG. 3.
Comet Orkisz, 1925 April 23.40 U. T.

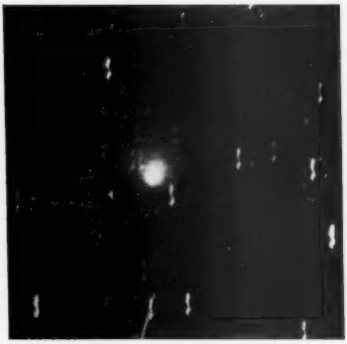

FIG. 4.
Comet Tempel II, 1925 July 23.15 U. T.

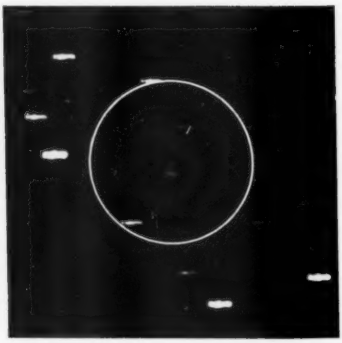

FIG. 5.
Comet Faye, 1925 October 22.40 U. T.

PHOTOGRAPHS OF THE COMETS OF 1925.

PLATE VIII.

FIG. 6.
Comet Van Biesbroeck, 1925 November 21.45 U. T.

FIG. 7.
Comet Wilk-Peltier, 1925 December 10.00 U. T.

PHOTOGRAPHS OF THE COMETS OF 1925.

Periodic comet Borrelly 1925*f*, which appeared next in the chronological order, became considerably brighter than the previous one. It was found on August 14 by A. Schaumasse, at Nice (France), by means of an ephemeris computed at that observatory. On August 18, I estimated it as of 13^M; it appeared as a small nebulosity with a tail of 1′, in position angle 90°. In the following months it brightened up to 10^M, the tail-like appendix being quite noticeable all of the time. When last seen here on January 19, 1926, it was only of 13^M, with the tail in position angle 280°. Still well situated for observation in the northern sky, it will probably be followed for quite a while.

Two more faint periodic comets, Brooks (1925*g*) and Faye (1925*h*), were found near the predicted places on September 22 in Simeis and on October 20 in Bergedorf, respectively. Both were subsequently found on plates taken before the date of their first recovery. Comet Brooks was recorded here on October 10 as an elliptic nebulosity with an eccentrically placed nucleus situated towards the preceding side. It was then estimated at $13^M.5$ and did not become any brighter afterward. When last photographed, on December 10, with the 24-inch reflector I estimated the brightness at $15^M.5$. Comet Faye was hardly more conspicuous. On October 22 (Fig. 5) it showed a 14^M nucleus with a very faint tail 3′ long in position angle 60°. This plate was exposed for 30 minutes with the 24-inch reflector; the comet appears very faintly. Like most faint comets it was very inactive photographically. In January, 1926, it had faded to 15^M but was still in good position for further observations.

The month of November was marked by the appearance of two unexpected cometary visitors.

On November 17, I turned the 40-inch telescope on the field of Comet Orkisz with the purpose of determining the position after its conjunction with the sun. In locating the field in the 4-inch Mellish finder, I was struck by the sight of an entirely different comet (*P. A.*, Vol. 33, p. 697). I knew Comet Orkisz was quite faint at that time, while here was a large object, fully 8^M in brightness; it had a sharp nucleus surrounded by a well-defined paraboloid envelope extending in a northwestern direction into a tail visible over 30′. It was an impressive sight. The hope of seeing Comet Van Biesbroeck 1925*j* develop into a spectacular appearance was however quickly shattered. At discovery the object was already six weeks past its perihelion and soon it showed a marked decrease in brightness. The weather interfered badly with the photographic observations and besides the lack of blue light in the comet made the object decidedly fainter on the plate than it appeared to the eye. Fig. 6 is an enlargement from a 60-minute exposure with the 24-inch reflector obtained on a rather poor night, November 21. It shows the general appearance on that date, but the tail can be traced to only 15′ from the head on the original plate, while visually it was plainly visible over twice that extent. With the increasing distances from both the sun and earth the comet decreased rapidly in brilliancy.

When last observed here (January 19, 1926) the brightness was estimated only $10^{M}.2$, but the tail was visible over a length of 8′ in the 4-inch finder. We expect to follow this comet for several months.

The other fairly bright November comet was first found by the enthusiastic variable star observer L. Peltier at Delphos (Ohio) on November 14. His report of a rough position with the indication "motion southeast" reached the observatories after some delay, and in the meantime the object was independently found on November 19 by Wilk (Cracow, Poland), who gave the first accurate position and sent out the first telegraphic announcement. The object designated as Comet Wilk-Peltier 1925*k*, when first observed here on November 21, appeared as a round diffuse nebulosity, 2′ in diameter with a coarse nucleus. The brightness was estimated as $7\frac{1}{2}^{M}$ so that it was not very much below the limit of naked eye visibility. A photographic plate on that date showed a faint narrow tail in position angle 25° extending to about 15′ from the nucleus. Soon the moon interfered with photographic observations. When the object was photographed again on a black sky, December 10, it had the striking appearance shown by Fig. 7, obtained from a 24-minute exposure with the 24-inch reflector. The comet was then only three days past its perihelion. The tail is quite plain as far as 43′ from the head; it can be traced fading out gradually for 13′ more, making a total of nearly one degree. From the round head, about 3′ in diameter, emanates a wide bundle of streamers, the axis of which is marked by a straight threadlike streamer in position angle 53°. At 20′ from its origin the tail begins to spread out and takes at the same time a somewhat devious course. Of the lateral streamer, noticed on December 8 by M. Wolf at 10′ from the head on the south side, there is left no other indication than a slight brightening up at 17′ distance. That part of the tail material seems therefore to have travelled about 7′ in an interval of 1.2 days. Over most of its length the southern edge of the tail is somewhat sharper than the northern.

In its rapid southward motion the comet soon became difficult to observe. It was followed here in its decline until the last of the year when the brightness had decreased to about $10^{M}.5$. Further observations will probably be obtained in the southern hemisphere.

Finally, before the year was over another new comet was reported from South Africa. Discovered by Ensor at Pretoria it was described as of 8^{M}, with a tail 15′ long. Computation indicates that this object will brighten up as it moves north in February and March. Is this going to be a bright naked eye object such as we have not seen for many years?

Williams Bay, Wisconsin, February 6, 1926.

NOTE ADDED MARCH 18.

Our search for comet Ensor has been unsuccessful. I tried it with the 6-inch comet-seeker in the second part of February without finding anything. A photographic search by F. Ross was not more successful,

but on account of moonlight the exposures could not be long, and reached only 11 minutes. Longer exposures in March were not more successful in bringing out the vanished comet. After examining the plates taken on March 15 with the 24-inch reflector I am convinced that no cometary object as bright as 16^M was near the predicted position.

G. v. B.

TIME BY THE BIG DIPPER.

By CHARLES CLAYTON WYLIE*
and WILLIAM WALTER MERRYMON.†

The idea of using the pointers of the Dipper, α and β of the constellation Ursa Major, for the determination of local mean time is not original with us;[1] but in the few references we have seen, there is no method suitable for persons whose knowledge of astronomy is limited to that ordinarily given in grade school courses in geography and general science. The following methods have been developed especially for such persons, and in the explanation such terms as hour angle and sidereal time are therefore carefully avoided. These have been used for some years, and it is believed they are of practical value. For example, a camper, whose watch had been allowed to run down, could reset it with sufficient accuracy for all ordinary purposes by reading from the Big Dipper a few times in the course of the evening.

Everyone who has watched the Dipper has noticed that it appears to circle about the pole star, and that its direction of motion is counter-clockwise. Since this apparent motion is due to the rotation of the earth, and since the earth turns on its axis once in 24 hours, the Dipper circles about the pole star once in 24 hours.

If now we regard the northern sky as a giant clock face, with the hour hand pivoted at the pole star and extending to the pointer stars of the Big Dipper, the reading of this giant clock will decrease one hour for each two hours of elapsed time. For example, if the pointers are out to the left (9 o'clock reading) at 7 P. M., they will be directly below, (6 o'clock reading) six hours later, at 1 A. M.

Looking at the Dipper occasionally throughout the year, one notices that its position as seen in the early evening sky changes. This is due to the revolution of the earth about the sun. As the earth spends twelve months in its circuit, and there are 12 hours on the clock face, the reading of the giant clock in the northern sky will change one hour per month, to a person watching at the same time each evening.

From these considerations, the following rules for obtaining the time were formulated:

*University of Iowa, Iowa City, Iowa.
†Westinghouse Research Laboratories, Bloomfield, New Jersey.
[1] Molesworth, Military Uses of Astronomy, Scientific American, January, 1926.

METHOD I.

Imagine the northern sky a giant clock face, the hour hand extending from the north star to the pointers of the Dipper.

1. Read the time by this clock, i e., read the sky, estimating the quarter hour.

2. Add to this the number of months since New Year's day, to the nearest quarter month. This reduces the sky reading to what it was at this particular hour at night on January 1. We saw that the motion of the earth about the sun changed the reading one hour per month.

3. Double the above sum, (there are 24 hours in the day and but 12 on the sky clock face).

4. Subtract from 16¼, or, if the doubled sum is larger than 16¼, $24 + 16\frac{1}{4} = 40\frac{1}{4}$. This constant, 16¼, is double the reading of the northern sky at noon on New Year's day. We saw that the sky reading decreased one hour for each two hours of elapsed clock time. Therefore if the sky reading at some other hour on January 1 is doubled, as by Rule 3, and subtracted from the above constant, the result will be the clock hours after noon, or the local time P. M. If it is over 12, subtract 12 and call it A. M.; that is 13 P. M. is 1 A. M., 14 P. M. is 2 A. M., etc.

METHOD II.

Since the Dipper circles about the north star in a counterclockwise direction, it occurs to one that the use of a reversed clock dial, such as one sees in a mirror, might simplify matters. The readings would then increase in the direction of the Dipper's apparent motion. If we also count the time from September 5, the day on which the northern sky clock reads 12 at noon, we obtain the following rules.

1. Read the northern sky, regarding it a giant clock face reversed, (the figure 3 being to the west, and 9 to the east), to the estimated quarter hour.

2. Subtract from the sky reading the months after September 5, or add the months before September 5, to the quarter month. (This reduces the sky reading to the same hour at night on September 5.) If over 12, subtract that amount to obtain the reading.

3. Double. This is the local time in hours P. M. If over 12 subtract that amount and call the result A. M.

EXAMPLE.

On the evening of February 22 the reading of the northern sky is estimated to be 2:30. Required the local mean time.

Reduction by Method I.

$2{:}30 = 2\frac{1}{2}$. It is 1¾ months since New Year. $2\frac{1}{2} + 1\frac{3}{4} = 4\frac{1}{4}$. Doubling, $4\frac{1}{4} \times 2 = 8\frac{1}{2}$. Subtracting, $16\frac{1}{4} - 8\frac{1}{2} = 7\frac{3}{4}$. It is 7¾ hours since noon, or 7:45 P. M.

Reduction by Method II.

Reading on a reversed clock dial the 2:30 would have been called 9:30. $9{:}30 = 9\frac{1}{2}$. It is 5½ months since September 5, subtracting,

$9\frac{1}{2} - 5\frac{1}{2} = 4$. Doubling, $4 \times 2 = 8$. It is 8 hours since noon, or 8 P. M.

In this example, the two methods give results differing by a quarter of an hour, which often happens. The reductions can, of course, be made more accurately by arranging them for days and minutes, instead of quarter months and quarter hours, but the accuracy possible in reading the sky hardly justifies the labor. The rules as given are easily memorized, and the reductions are simple mental calculations.

Error of Result.

This method of determining time has been tried in various parts of the United States, and to some extent outside its bounds. With a good view of the northern sky, an error of fifteen or twenty minutes is reasonable. Larger errors may occur when hills or trees cause one to misjudge the northern horizon. Some error occurs when the Dipper is approximately on a level with Polaris, as the 9 o'clock and 3 o'clock positions are not when the pointers are at the same altitude as Polaris, but when they are on the great circle passing through Polaris and the east and west points of the horizon.

The step of doubling in the calculation necessarily doubles the effect of any error in reading or in figuring the fraction of month. On the other hand, the error in reading can be reduced by repeating an hour or so later, and averaging the results. For example, if the watch is set by a reading in the early evening, readings can be taken to determine its error two or three times in the course of the evening, and it can then be reset to allow for the average error indicated.

Longitude Correction.

The preceding formulae give local mean time, which is theoretically correct only on the standard meridian. Practically, in work of this accuracy, the longitude correction can be neglected at most places, but for completeness the method of correcting to standard time is included. For scoutmasters and travellers, the best method is probably to obtain the local mean time, and correct by adding 4 minutes for each degree west of the standard meridian, or subtracting 4 minutes for each degree east. Thus, if Detroit and Boston are both keeping Eastern (75th meridian) time; for Detroit, 8 degrees west, 32 minutes is added, and for Boston 4 degrees east, 16 minutes is subtracted. If daylight saving time is being used, an hour must be added on that account.

Astronomers working at an observatory some distance from the meridian may prefer to correct the constant to give standard time directly, but it should be made clear to students and others that in general the constant for local mean time, as given in the methods above, should be used. The $16\frac{1}{4}$ hours used in Method I is, more accurately, $16^h\ 20^m$. The longitude correction of 4 minutes per degree can be added to or subtracted from this; giving $16^h\ 52^m$ (roughly $16\frac{3}{4}$ hours) for Detroit, and $16^h\ 4^m$ (roughly 16 hours) for Boston.

In Method II the date September 5 is advanced one day for each degree west of the standard meridian, and vice versa for stations east. At Detroit, September 13 would be used, and at Boston, September 1.

The Use of Kochab.

At times, in our latitudes, the pointers of the Dipper are low, and buildings and trees make an estimate difficult or impossible. At such times Kochab, Beta Ursa Minoris, can be used. The reading by Kochab is two hours greater direct, or two hours less on a reversed clock dial, than that by the pointers. If it is desired to reduce these readings directly the constant for Method I would be 20¼ hours instead of 16¼ and in Method II, the date November 3, should be used instead of September 5.

January 19, 1926.

HIGH FREQUENCY RAYS OF COSMIC ORIGIN.*

By R. A. MILLIKAN.†

It was as early as 1903 that the British physicists, McLennan and Burton[1] and Rutherford and Cooke[2] noticed that the rate of leakage of an electric charge from an electroscope within an air-tight metal chamber could be reduced as much as 30 per cent by enclosing the chamber within a completely encircling metal shield or box with walls several centimeters thick. This meant that the loss of charge of the enclosed electroscope was not due to imperfectly insulating supports, but must rather be due to some highly penetrating rays like the gamma rays of radium, which could pass through metal walls as much as a centimeter thick and ionize the gas inside.

In view of this property of passing through relatively thick metal walls in measurable quantity, the radiation thus investigated was called the "penetrating radiation" of the atmosphere, and was at first quite naturally attributed to radioactive materials in the earth or air, and this is in fact the origin of the greater part of it. But in 1910 and 1911 it was found that it did not decrease as rapidly with altitude as it should upon this hypothesis. The first significant report upon this point was made by the Swiss physicist, Gockel,[3] who took an enclosed electroscope up in a balloon with him to a height of 13,000 feet and reported that he found the "penetrating radiation" about as large at this altitude as at the earth's surface, and this despite the fact that according to Eve's[4] calculation it ought to have fallen to half its surface value in going up 250 feet.

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†Norman Bridge Laboratory, California Institute of Technology.

In 1911, '12, '13 and '14 two physicists, Hess,[5] a Swiss, and Kolhörster,[6] a German, repeated these balloon-measurements of Gockel's, the latter going to a height of 9 km., or 5.6 miles, and reported that they found this radiation decreasing a trifle for the first mile or so and then increasing until it reached a value at 9 km., according to Kolhörster's measurements, eight times as great as at the surface. This seemed to indicate that the penetrating rays came from outside the earth, and were, therefore, of some sort of cosmic origin. If so it was computed[7] that in order to fit the Hess and Kolhörster data the rays had to have an absorption coefficient of 0.57 per meter of water and an ionizing power within a closed vessel sent to the top of our atmosphere of at least 500 ions per cc. per sec., in place of the 10 or 12 ions found in ordinary electroscopes at the surface. The war put a stop the world over to further studies of this sort, but as soon as we could get the proper instruments built after the war in the newly equipped Norman Bridge Laboratory of Physics, I. S. Bowen and myself went to Kelly Field, near San Antonio, Texas, with four little recording electroscopes which we succeeded in the spring of 1922 in sending up in sounding balloons to almost twice the heights which had previously been attained. The highest flight reached the altitude of 15.5 km., or nearly 10 miles.

These instruments were interesting in that, though they were built of steel to hold 300 cc. of air at 150 lbs.' pressure, and were provided each with a recording barometer, thermometer and electroscope, also with two different sets of moving photographic films and the necessary driving mechanism, the total weight of the whole instrument was yet but 190 grams, or about 7 ounces. The altitudes were determined not only from the now well established law of ascent of balloons, but also by direct, two theodolite observations which Major Wm. R. Blair of the U. S. Signal Corps kindly sent Lieutenant McNeil to Kelly Field for the express purpose of making for us.

In these experiments we expected, if the results previously reported were correct, to find very large rates of discharge; for our instruments went up to such heights that eighty-eight per cent of the atmosphere had been left beneath them, and only twelve per cent was left to cut down, by its absorption, the intensity of the hypothetical rays entering from outside. In other words, our electroscopes should have been exposed to radiations approaching in intensity those existing at the very top of our atmosphere. *We actually failed to find anything like the computed rates of discharge.* Our experiments were in agreement with those of the European observers in that our electroscopes showed a somewhat higher rate of discharge at high altitudes than at the surface, but at the same time they proved conclusively that *a radiation of the assumed properties did not exist, our observed rates of discharge being not more than one-fourth the computed amounts.*

Since the origin of the "penetrating rays" was still uncertain, Dr. Russell Otis and myself in the summer of 1923 went to the top of Pike's Peak for the sake of making absorption experiments upon these radia-

tions at the highest altitude to which we could carry large quantities of absorption materials. For if the rays were not of cosmic origin they did not need to be more penetrating than are the gamma rays from radioactive materials, while if they were of cosmic origin the sounding balloon experiments of Bowen and myself had shown that they must be very much harder (more penetrating) than anybody had thus far assumed. What was needed was absorption experiments to determine just what sort of rays they actually were.

We carried 300 pounds of lead and a 6′ x 6′ x 6′ tank of water to the top of the peak and obtained as the net result of these absorption experiments the definite proof that the rays found at the top of Pike's Peak were predominantly of the hardness of ordinary gamma rays, and further that they were very largely, if not entirely, of local origin, since local conditions, such as a heavy snow storm and blizzard, which occurred while we were there, varied their intensity nearly as much inside a screen of 4.8 cm. of lead as outside. Kolhörster had by this time, after the brief publication of our Kelly Field data, and as a result, also, of new experiments made subsequently to them in crevasses and holes in glaciers in the Alps reduced his estimated absorption coefficients[8] from 0.57 to 0.25, a change he regards as within the limits of his experimental uncertainties, but a change which made the assumed rays so hard as to be no longer irreconcilable with our sounding balloon observations. But we found that our Pike's Peak observations were not yet compatible with his now (1923) assumed characteristics of rays of cosmic origin, viz., rays which produce 2 ions per sec., per cc. at the earth's surface, and have a coefficient of 0.25 per meter of water. For while in going from the altitude of Pasadena to that of Pike's Peak the number of ions observed with the unshielded electroscope increased from 11.6 to 22.2, an increase of 10.6 ions, the number of ions observed through the shield of 4.8 cm. of lead increased but from 9.37 to 11.6, an increase of only 2.23 ions. But radiation of the characteristics assumed above would have caused by itself, inside our lead screen, an increase of 3.34 ions, even if *none* of the large increase in radiation shown by the unshielded observations got through the lead shield—a supposition which we believed to be contrary to fact. In a word, our *Pike's Peak observations showed that if rays of cosmic origin existed at all they must be of different char cteristics from any as yet suggested, and they further showed most interestingly that a very copious soft radiation of unknown origin existed at the altitude of Pike's Peak.*

Accordingly, Mr. Harvey Cameron and myself planned some new experiments for the summer of 1925 which were designed

(1) To settle definitely the question of the existence or non-existence of a small, very penetrating radiation of cosmic origin—a radiation so hard as to be uninfluenced by, and hence unobservable with the aid of, such screens as we had taken to Pike's Peak—and,

(2) To throw light on the cause of the variation with altitude of the radiation of gamma-ray hardness which our absorption experiments on

Pike's Peak showed to be more than twice as copious there as at Pasadena.

The only possible absorbing material obtainable in the immense quantities needed, and of homogeneous and non-radioactive constitution, were the waters of very deep snow-fed lakes—snow-fed because the results of underwater experiments which we had previously carried on near Pasadena had been vitiated by our discovery that the waters were appreciably radioactive. We felt that there was much uncertainty as to how much this cause might have affected the European observations in and about glaciers. Further, our Pike's Peak experiments had demonstrated that if any of the penetrating rays were of *cosmic origin* the ionization due to them in our electroscope at sea level had to be much less than the 2 ions, assumed above, out of the 11.6 observed, the experimental error being, say, half an ion. No crucial tests could, therefore, possibly be made unless we could find very deep, non-radioactive lakes at very high altitudes where cosmic rays, if they existed, had two or three times the ionizing effect to be expected from them at sea level. We needed at least three ions due to cosmic rays, to vary with absorbing materials, if we were to obtain unambiguous evidence.

We chose for the first experiments Muir Lake (11,800 feet high), just under the brow of Mount Whitney, the highest peak in the United States, a beautiful snow-fed lake hundreds of feet deep and some 2000 feet in diameter. Here we worked for the last ten days in August, sinking our electroscopes to various depths down to 67 feet. *Our experiments brought to light altogether unambiguously a radiation of such extraordinary penetrating power that the electroscope-readings kept decreasing down to a depth of 50 feet below the surface.* The atmosphere above the lake was equivalent in absorbing power to 23 feet of water, so that here were rays so penetrating that, if they came from outside the atmosphere, they had the power of passing through $50 + 23 = 73$ feet of water, or the equivalent of 6 feet of lead, before being completely absorbed. The most penetrating X-rays that we produce in our hospitals cannot go through half an inch of lead. Here were rays at least a hundred times more penetrating than these, and having an absorption coefficient but one twenty-fifth, instead of "about one-tenth of that of the hardest known gamma rays."[8]

How unambiguous was the experimental evidence may be seen from the fact that with the aid of a new electroscope of high sensitivity the change in ions per cc. per sec. in going from the surface of Muir Lake to the depth of 15 meters (50 feet) was from 13.3 ions to 3.6 ions, or a decrease to about a fourth value. The largest decrease below a surface reading reported by Kolhörster due to sinking electroscopes in water[8] was 2.1 ions, or a decrease of perhaps 20 per cent, so that we have here obtained an altogether new precision of measurement and unambiguity of evidence.

To obtain definite evidence as to whether these very hard rays were of cosmic origin, coming in wholly from above and using the atmo-

sphere merely as an absorbing blanket, we next went to another very deep snow-fed lake, Lake Arrowhead in the San Bernardino mountains, 300 miles farther south and 6700 feet lower in altitude, where the Arrowhead Development Company kindly put all their facilities at our disposal. The atmosphere between the two altitudes has an absorbing power equivalent to about 6 feet of water. *Within the limits of observational error, every reading in Arrowhead Lake corresponds to a reading 6 feet farther down in Muir Lake, thus showing that the rays do come in definitely from above, and that their origin is entirely outside the layer of atmosphere between the levels of the two lakes.*

Analysis of our absorption curves shows that the rays are not homogeneous but are hardened as they go through the atmosphere, just as X-rays are hardened by being filtered through a lead screen. Our hardest observed rays have an absorption coefficient of 0.18 per meter of water and the softest which get down to Muir Lake a coefficient of 0.3 per meter. The sounding balloon experiments of Bowen and myself make it improbable that they become very much softer than this at the top of the atmosphere, since otherwise we should have obtained larger readings in our very high flight.

Observations carried on day and night for four consecutive days on Pike's Peak at an altitude of 14,100 feet, and for two consecutive days on Mount Whitney at an altitude of 13,500 feet reveal no preferential direction in the heavens from which the rays come. *Within the limits of our uncertainty of measurement, then, these rays shoot through space equally in all directions.*

When absorption coefficients are reduced to wave-length by a formula[9] of probable, though not yet of certain, validity our hardest observed rays have the wave-length 0.00038 A, and those of longer wave-length go up to nearly twice this value, i. e., *we find a spectrum about an octave in width in a frequency region about 2000 times higher than that of the mean X-ray* (1 A), *or as far above X-rays as X-rays are above light.* The shortest wave-length just computed corresponds to a frequency 10,000,000 times higher than that of visible light.

When these extraordinarily high frequency rays strike the earth, according to the now well-established Compton effect, *they should be transformed partially into soft rays of just about the hardness of the soft rays which we have actually observed on Pike's Peak and Mount Whitney.* The reason these soft rays were more plentiful on the mountain peaks than at Pasadena would then be found simply in the fact that there are about three times as many of the hard rays to be transformed at the altitudes of the peaks as at that of Pasadena. This seems to be the solution of the second of our summer's problems.

We can draw some fairly reliable conclusions of a general sort as to the origin of these very penetrating and very high frequency rays. The most penetrating rays that we have known anything about thus far, the gamma rays of radium and thorium, are produced only by nuclear transformations within atoms. In other words, they are produced by

the change of one atom over into another atom, or *by the creation of a new type of atom.* It is scarcely possible, then, to avoid the conclusion that these still more penetrating rays which we have here been studying are produced similarly by nuclear transformations of some sort. But these transformations must be enormously more energetic than are those taking place in any radioactive changes that we know anything about. For, according to our present knowledge, the frequency of any emitted ray is proportional to the energy of the subatomic change giving birth to it. *We can scarcely avoid the conclusion, then, that nuclear changes having an energy value perhaps fifty times as great as the energy changes involved in observed radioactive processes are taking place all through space, and that signals of these changes are being sent to us in these high frequency rays.*

The energy of the nuclear change that corresponds to the formation of helium out of hydrogen is known, and from it we have computed the corresponding frequency and found it to correspond closely to the highest frequency rays which we have observed this summer. *The computed frequencies of these cosmic rays also correspond closely to the energy involved in the simple capture of an electron by a positive nucleus.* Thus, the highest speed β-ray emitted by thorium leaves its mother atom with a speed which is equivalent to the energy acquired by the fall of an electron through 7,540,000 volts.[10] This electron in order to get out of the mother atom was obliged to move against the pull upon it of the positive nucleus, and in this act it gained a potential energy the equivalent of a fall through 4,400,000 volts.[11] If this same electron had reversed its path and plunged into the nucleus it should have generated in so doing a 12,000,000 volt ray (7,540,000 + 4,400,000). The cosmic rays with which we have been dealing have frequencies which make them the equivalent of from 12 to 30 million-volt rays. It is not improbable that the capture of an electron by the nucleus of a light atom involves a higher energy than its capture by a heavy one, so that such captures as are here discussed constitute, perhaps, the most plausible hypothesis as to the origin of these rays.

Is it possible to imagine such a phenomenon going on all through space? The difficulty is not so insuperable, in view of the transparency even of large amounts of matter for these hard rays combined with Hubble's recent proof[12] at the Mount Wilson Observatory that some of the spiral nebulae are at least a million light years away. The centers at which these nuclear changes are taking place would then only have to occur at extraordinarily widely scattered intervals to produce the intensity of the radiation observed at Muir Lake.

The only alternative hypothesis to that above presented of high frequency rays traversing space in all directions might seem to be to assume that the observed rays are generated in the upper layers of the atmosphere by electrons shooting through space in all directions with practically the speed of light. This hypothesis might help some in interpreting the mysterious fact of the maintenance of the earth's nega-

tive charge, but it meets with insuperable obstacles, I think, in explaining quantitatively the variation with altitude of the ionization in closed vessels. In any case, in its most important aspect, this hypothesis is very much like the one presented above, for it, too, fills space with rays of one sort or another traveling in all directions with the speed of light. From some such conception as this there now seems to be no escape. And yet it is a conception which is almost too powerful a stimulus to the imagination. Professor MacMillan of Chicago will wish to see in it evidence for the condensation into matter out somewhere in space of the light and heat continually being radiated into space by the sun and stars,[13] an altogether permissible speculation. Unfortunately the psychics will of course be explaining all kinds of telepathies with the aid of these cosmic rays. But, be that as it may, the simple experimental facts, as shown by the foregoing work, are:

(1) That these extraordinary penetrating rays exist;

(2) That their mass absorption coefficient may be as high as 0.18 per meter of water;

(3) That they are not homogeneous, but are distributed through a spectral region far up above X-ray frequencies—probably 1000 times the mean frequencies of X-rays;

(4) That these hard rays stimulate, upon striking matter, softer rays of about the hardness predicted by the theory of the Compton effect;

(5) That these rays come into the earth with equal intensity day and night and at all hours of the day or night, and with practically the same intensity in all directions.

M. I. S. Bowen, Dr. Russell Otis, Mr. G. Harvey Cameron and myself, all of whom have participated in this investigation and have received invaluable aid from the instrument maker, Mr. Julius Pearson, will publish full details of this work elsewhere.

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[7] E. v. Schweidler, Elster u. Geitel Fest schrift, p. 415, 1915.
[8] Kolhörster, *Sitz.-Ber. Preuss. Akad. Wiss.*, **34**, 366, 23.
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[10] Report of Committee on X-Rays and Radioactivity of National Research Council, 1925, p. 92.
[11] Report of Committee on X-Rays and Radioactivity of National Research Council, 1925, p. 68.
[12] Hubble, *Pop. Astron.*, **33**, pp. 252-255, 1925.
[13] MacMillan, *Science*, **62**, 122, 1925.

THIRTY-FIFTH MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY.

(Continued from page 190.)

ON THE RELATION BETWEEN TIME AND INTENSITY IN PHOTOGRAPHIC EXPOSURE.

By L. A. Jones, E. Huse, and V. C. Hall.

Work has been continued on the failure of the photographic reciprocity law, $E = It$. The failure of this law using panchromatic and orthochromatic emulsions is somewhat greater than reported previously for high-speed non-color sensitive emulsions. Slow ordinary and lantern emulsions show very great failure and also a marked change of gamma with intensity. In general, for fast plates the variation of density with intensity is small, optimal intensity is at a low value, and gamma is independent of intensity. For slow plates the density variation is great, optimal intensity high, and gamma drops at low intensities. As found by Kron, optimal intensity shifts to higher values with increasing development time.

Kron's usually accepted empirical law does not fit the observed data. An alternative form

$$It = \tfrac{1}{2} I_0 t_0 [(I/I_0)^a + (I/I_0)^{-a}]$$

has been found to fit the observed data for fast plates over a range of 1:8,000,000 in intensity and to fit the data for slow plates at high intensities. The observed failure is greater than the calculated curve indicated for these emulsions at low intensities. This equation was suggested by Kron but it did not fit his observations. The observed data thus far indicate that the dependence of gamma on intensity follows as a result of changes in the effective grain size frequency function caused by a differential failure of the reciprocity law for grains of different sizes and sensitivities.

EFFICIENCY OF EARLY AND RECENT PHOTOGRAPHIC PLATES.

By Edward S. King.

The comparison of plates used at different periods is based on the joint efficiency of the emulsion and the developer. Laboratory tests made during the last 30 years have been utilized to compare the emulsions. The actual photographic darkening of the film has been taken as the measure of sensitiveness. As this includes the effect of development, the result expresses the total efficiency of plate and developer. During the 30-year period, a possible gain of 0.5 magnitude is shown. The apparent gain for 1925 over 1910 is 0.8 magnitude; over 1903 only 0.3 magnitude.

The electric lamp, furnished by the U. S. Bureau of Standards, corroborates the Argand. Study of photometric squares near the "threshold" value of the plates shows results for 1916 equal to those for 1925, but with a drop in sensitiveness for 1920.

Extra-focal images with the 11-inch Draper telescope confirm the constancy of the Argand, and the tests made with it. Extra-focal images with the 8-inch Draper telescope, comparing results for 1914 and 1925, show no material change in sensitiveness.

Limiting magnitudes on plates taken with the 16-inch Metcalf telescope indicate no great change from 1914 to the present time, though the best recent plates show stars 0.8 magnitude fainter than the best in 1919.

The general conclusion appears that photographic plates show no marked improvement in sensitiveness as applied to astronomical purposes. However, there is an interesting and valuable property possessed by some of the modern emulsions. This is the capability to stand prolonged development. A few years ago, all emulsions known to us would reach a maximum of density after about 8 minutes developing in our standard solution. Longer development would soon cause reversal. It is now possible to develop certain emulsions for 40 minutes without any great harm. Therefore, we are now developing all our regular plates for nearly twice as long as they were five years ago.

The results as to the comparative efficiency of plates, including the action of the developer, show only slight changes. The compilation leading to these results has been rather hastily prepared, and may be modified by further inquiry.

THE COLOR SENSITIVITY OF PHOTOGRAPHIC MATERIALS.

By C. E. Kenneth Mees.

The spectral sensitivity of silver bromide, silver iodide, and silver chloride corresponds approximately to their absorption and extends therefore from the blue to the violet and ultra-violet. Recent measurements made with great precision seem to show that the sensitivity for the same energy increases slightly towards the ultra-violet, and this increase continues probably without any decrease as far as it is practicable to measure it.

The practicability of the sensitivity of materials in the ultra-violet is limited by the absorption of gelatine, and for work in the extreme ultra-violet it is necessary to use materials free from gelatine or else sensitized by some substance such as paraffin oil, which fluoresces, converting the ultra-violet to blue light. It was first discovered by Vogel that the addition of certain dyes to the silver bromide could confer color sensitiveness corresponding to the absorption region of the dye in question. For many years erythrosine was the chief practical sensitizer used, but about 1900 a group of dyes known as the isocyanines was discovered, and in 1904 pinacyanol was introduced, thus making it possible to prepare materials sensitive to the whole of the visible spectrum; these are known as "panchromatic" materials.

In the last few years sensitizers have been discovered which extend the sensitiveness through the infra-red, so that at the present time it is

possible without any difficulty to photograph from the extreme ultra-violet to 900 milli-microns. This great extension of spectral sensitivity has aided in the substitution of photography for visual observation for all classes of optical instruments. The telescope and spectroscope already employ photographic methods almost exclusively, and for precise research work it is probable that the microscope will follow their example.

ULTRA-VIOLET SOLAR RADIATION AND ITS VARIATIONS.

By Edison Pettit.

In 1922 Dobson at Oxford compared photographically the solar energy transmitted by a silver film with that emitted by a standard lamp on 34 days. Variations reaching 500 per cent in extreme, and a standard deviation of 30 per cent from day to day were found. This startling result led me to investigate these variations in ultra-violet solar radiation transmissable by silver films with different apparatus.

It was thought that the use of the standard lamp could be eliminated by comparing the solar radiation transmitted by the silver film ($\lambda = 3100 - 3200$) with that transmitted with a gold film backed by a green screen ($\lambda = 4800 - 5000$), and, that by measuring the energy directly with a vacuum thermocouple, the uncertainties of photography could be eliminated.

Briefly, this apparatus consists of two lenses of quartz of one-half inch aperture and two inches focal length, having a quartz plate mounted in front of each, the whole set into an air-tight cell. The inner faces of one of these is silvered with dense films, and the other is gilded by sputtering, and has a green piece of celluloid placed between the lens and plate. These two cells are mounted on a disk which is rotated by a motor. The amount of rotation is controlled by a contact-clock and escapement, and in such a way that the image of the sun, 1 mm in diameter, formed by each cell, is caused to fall first on one junction, then the other junction of a vacuum thermocouple, after which a half rotation interchanges the lenses and the action is repeated at intervals of one minute. A galvanometer connected to the thermocouple registers its deflections photographically upon a moving plate driven by a steel wire running over the hour circle of the 6-inch telescope upon which the whole apparatus is mounted. With this equipment a complete comparison between the ultra-violet light at the extreme end of the solar spectrum and the green light at the maximum of solar energy is made every four minutes throughout the day, the operation being automatic and requiring little supervision.

The deflections are measured on a machine, and the ratios between the violet and green taken for each four minutes. The log of this ratio is plotted against air mass (sec z) and the resulting straight line projected to the zenith and no atmosphere. The extrapolations of the afternoon runs to no atmosphere always give greater values than the

morning runs, and this appears to be closely associated with the greater sky whiteness at that time. For this reason only morning observations have been used for statistical purposes.

Experimental runs were obtained in the summer of 1924, and daily runs were begun in June, 1925. The daily values of the ratio of ultra-violet to green light for one atmosphere and no atmosphere were compared with the sky whiteness, solar constant, and sun-spot numbers for a period of two months, and a general correspondence with solar activity is noted.

The amount of ultra-violet light has increased 80 per cent since June, 1924, and the amount of increase is the same for one and no atmosphere. It is believed that the air-tight cells so efficiently protect the films that this observed increase cannot be attributed to change in the filters. Again, even exposed to air, the gold would be much more permanent than silver, whose transmission would decrease with tarnish if this occurred. The transmission would have to increase rather than diminish, however, to explain this increase in ultra-violet light. Occasional spectroscopic observations will be made to check these variations in the future. A test film has also been prepared to study the effect of age upon transmission.

That the atmosphere plays an unimportant part and is effectively eliminated is indicated by the fact that the per cent of variation at one atmosphere is the same as that at no atmosphere, ten-day means giving this result with a maximum residual of 5 per cent.

A laboratory investigation has been carried on to study the absorption properties of ozone in the ultra-violet, and this shows that, with amounts even exceeding by 200 per cent the amount calculated by Fabry and Buisson for the atmosphere, the absorption in the region here investigated is negligible.

From these considerations then, it is believed that these variations are in the sun itself, and that during the past year and a half the solar ultra-violet light of wave-length 3100-3200 A has increased 80 per cent. This is in harmony with the increase in sun-spot frequency and the solar constant as determined by Abbot, and may assist in explaining the changes observed in the latter, at least when monthly means are considered.

The large variations observed by Dobson are probably due to haze, and his standard daily deviation of 30 per cent is reduced to 5 per cent in the Mount Wilson observations.

ATMOSPHERIC MOTION IN ζ GEMINORUM.

By W. Carl Rufus.

Systematic differences in the displacements of lines in the spectrum of ζ Geminorum have been found. Velocity-curves for high, intermediate and low levels, velocity-difference curves and an atmospheric compression curve have been formed and correlated with the light vari-

ation. An effect apparently due to ionization has also been isolated.

The Velocity-Curves. Forty-eight plates of ζ Geminorum made with the single-prism spectrograph of the Observatory of the University of Michigan were used. Twenty-six selected lines were grouped at three levels, six high, six intermediate and fourteen low. All of these lines were measured on each plate and all of the observations were given equal weight. The main features of the velocity curves agree with those found by Campbell and by Henroteau including the secondary variation on the descending branch. The curves at different levels, however, appear to differ in form and phase. In general the high curve has a higher and sharper maximum than the low curve with a lag of phase. Hydrogen seems to indicate a secondary variation or pause on the ascending branch and a very high maximum later than the other high-level elements. Orbital elements have not been determined, but it is evident that a different set would be required for each curve and there would be radical deviations from elliptic motion.

Velocity-difference Curves. High-minus-low and high-minus-intermediate curves were formed by plotting the velocity differences with respect to phase. The most striking feature of these curves is the sudden change from negative to positive near the time of light-minimum. Negative differences from light-maximum to light-minimum are quite smoothly distributed. After light-minimum the positive differences are found, but the curve is somewhat irregular corresponding with the irregularity of the velocity-curves. The amplitude of these curves is greater than one-third that of the velocity curve itself.

Assuming that the line displacements are due to the Doppler effect produced by the vertical motion of the layers of the atmosphere of the star, negative differences represent expansion and positive differences represent compression of the atmospheric gases. The process of expansion ends at the time of light-minimum, when compression begins and continues until light-maximum.

The Compression Curve. The two intermediate stages of compression were found from the high-minus-low velocity-difference curve by taking the time which divides the integral of expansion in two equal parts and likewise the time which divides the integral of compression. These phases are respectively 2.8 days and 7.4 days, which correspond approximately with the phases when the star is at its mean apparent magnitude. The stage of compression was then found by estimating the area under the curve by counting squares on coördinate paper. These values plotted with respect to phase gave the compression-curve. The relationship between this curve and the light-curve suggests that the state of the atmosphere of the star has a direct effect upon its apparent luminosity.

Isolation of an Ionization Effect. Systematic differences in the line displacements of ionized atoms and normal atoms were also found. The differences were taken in the sense ionized minus normal. Positive

differences indicate fall of the ionized atoms with reference to the normal and negative differences indicate rise. These differences plotted with respect to phase may be taken to represent the circulation of the ionized atoms. The amplitude of the curve is about ten kilometers. The maximum fall occurs approximately at 3.9 days and the maximum rise at 7.5 days. These correspond quite closely with minimum and maximum ionization as found by Henroteau. If ionization occurs at a low level and the ionized atoms are repelled, the circulation is readily explained.

ON THE PROBLEM OF STELLAR EVOLUTION.

By Henry Norris Russell.

Two sorts of internal equilibrium may be assumed to exist in the interior of a normal star: mechanical, the internal pressure balancing the gravitational pressure, and radiative, such that the rate of generation of energy balances the loss by escape to the surface.

In the stars, disturbances of mechanical equilibrium adjust themselves with a time of pulsation, varying from a few hours for dwarfs to a few weeks for giants. For disturbances of radiative equilibrium, the time of relaxation is of the order of a million years, since the internal store of heat is very great in comparison to the annual production or loss.

Under these conditions, mechanical equilibrium is stable if the effective ratio of the specific heats exceeds 4/3; radiative equilibrium is found to be so, if, when the star contracts, the rate of generation of energy inside it rises more rapidly than the rate of escape from the surface. Jeans's opposite conclusion applies to bodies in which the time of relaxation is smaller for radiative than for mechanical changes.

It may be shown that Eddington's relation between the mass and absolute magnitude of a star should hold true, within a magnitude or so, for all stars in mechanical equilibrium, even if they are not in radiative equilibrium.

The generation of heat within a star is now generally attributed to atomic transformations of some sort, leading to a gradual conversion of mass into energy. At present the laws which govern this process must be found, if at all, from the relation between the absolute magnitudes and spectral types of the stars. If the composition of the stellar material was in all cases the same, the rate of generation of energy would depend only on the temperature and pressure, and all stars of the same absolute magnitude would be of substantially the same spectral type. Hence at least two different processes must actually be at work within the stars.

A process which, under the conditions which prevail in a slowly contracting star, begins to be effective at about the same temperature whatever the density, will account for all the stars of the "main sequence" from the B-stars to the red dwarfs. A second process, which becomes

effective at a temperature rapidly increasing with the density, will account for the giant stars, and probably for the white dwarfs as well.

If a star of given mass starts with a large diameter it will contract, drawing on its gravitational energy, until the internal temperature becomes high enough to start the liberation of atomic energy, and then continue in this state for a very long time.

For a star of large mass, the second process will first come into operation, and, after the short period of gravitational contraction, it will start its career as a giant; for one of smaller mass, the first process comes into operation at the lower temperature of the two, and it starts its permanent career as a dwarf. If a star breaks up by fission into two components, or a great mass into a cluster of stars, each component will automatically approach within a few million years the steady state corresponding to its own mass. The relations which exist between absolute magnitude and spectrum among physical pairs and in star clusters may thus be explained without resort to the assumption that the components are of unequal age.

The course of evolution of a star depends on the proportion of active material within it. If this is but a small fraction of its mass, the absolute magnitude will be nearly constant during its career. A star of large mass will contract rapidly under gravitation, linger in a nearly steady state as a giant till the material exhaustible by the second process is gone, contract rapidly again till it reaches the main sequence, and the first process becomes active, linger again here and finally contract to a great density. For stars of small mass, the first process acts sooner, and the first stationary state is reached on the main sequence, as an ordinary dwarf; the second probably as a white dwarf.

If the transformable material forms most of the mass, the process of evolution is that recently sketched by the writer in *Nature*.

Evidence for discriminating between these two possibilities does not appear to be at hand.

NATURE OF PHOTOGRAPHIC SENSITIVITY.

By S. E. Sheppard.

It is pointed out that a number of definitions of photographic sensitivity are possible. Thus sensitivity may refer to the production of visible images, or to latent, developable images. Again, sensitivity may refer to color or wave-length of light. Finally, since the photographic emulsion consists of a number of individual silver halide grains, we must distinguish between plate sensitivity and grain sensitivity.

The measure of sensitivity is the reciprocal of the amount of energy required to produce a unit effect. In the case of grain sensitivity, it is therefore defined as the energy required to make a grain developable. Experiments with emulsion coated one grain thick have shown that the grains in an emulsion are not all equally sensitive. Further examination showed that while grains of larger size are more sensitive than the

smaller ones, the sensitivity is not the same even for grains of the same size. From experiments with oxidizing desensitizers, particularly chromic acid, pretreatment of which before exposure greatly reduces sensitivity, it is concluded that the sensitivity is due to the haphazard distribution of "sensitivity nuclei." The writer has shown that these nuclei probably consist of silver sulfide produced by certain reactive sulphur containing organic bodies present as impurities in the gelatin.

A theory of sensitizing is proposed according to which silver halide is the sensitive material and its actual photochemical sensitivity is unaffected by the presence of the nuclei. The function of the nuclei is to orient the photochemical decomposition around them, so that a nucleus large enough to induce developability is formed much sooner. Variations of this hypothesis are discussed, and other evidence discussed for the orientation theory. It is shown in particular that the orientation theory is consistent with optical sensitizing effects produced by deformation of the silver halide lattice by introduction of other substances. Such substances are colloidal silver, silver iodide, silver cyanide, and silver sulfide. The optical or color sensitizing produced by these may in all cases be attributed to the deformation of the ions in the silver halide crystal lattice, and the consequent lowering of the effective energy, $h\nu$.

The relation of this ionic deformation to normal color sensitizing by dyes is also discussed, and the importance of the reciprocal action of the silver halide on the dye and the dye on the silver halide is stressed.

Finally some notice is taken of the mechanism of desensitizing. Desensitizers are divisible into those used before exposure and those which exert their action during the exposure and which are only active during exposu to light. The action of the first type, such as chromic acid is most simply explained as due to the oxidation of the silver sulfide while the action of the second class, notably of dye sensitizers discovered by Lüppo-Cramer, requires another explanation. The most probable seems to be that for these dyes the oxidation potential is raised in light, tending to favor the reverse action. It is pointed out that whether a dye acts as an oxidizer or as a reducer in light depends upon the silver halide with which it is coupled.

SIMPLIFIED DEDUCTION OF THE DOPPLER-EFFECT FORMULA FOR ELLIPTIC SPACE.

By Ludwik Silberstein.

The previous deduction (*Philosophical Magazine* for October, 1924) of the Doppler-effect formula for any inertial motion of the star and the observing station in de Sitter's space-time is considerably simplified by making use at the outset of the first integral, $\cos^2\sigma\, cdt/ds = \gamma =$ const., of the geodesic equations. This gives for the element of the observer's proper time $ds = \cos^2\sigma\ cdt/\gamma$, and since the corresponding

proper-time interval of the star is (as *l. c.*, p. 622)

$$ds' = cdt[1 - (dr/c\,dt)\sec\sigma],$$

the Doppler-effect becomes at once

$$\delta\lambda/\lambda = ds/ds' - 1 = \cos^2\sigma/\gamma[1 - (dr/cdt)\sec\sigma] - 1, \qquad (1)$$

where r is the distance of the star at the moment of receiving its light, R the curvature radius of space-time or the associated elliptic space, c the light-velocity constant, and $\sigma = r/R$. This, together with the value

$$dr/cdt = \pm\cos\sigma\sqrt{1 - (\cos^2\sigma/\gamma^2)(1 + p^2/R^2\sin^2\sigma)}, \quad p = \text{const.}, \qquad (2)$$

another first integral of the geodesic equations, is the required rigorous formula, identical with (8), loc. cit. The signs correspond to receding and to approaching motion, giving a red and a violet spectrum shift, respectively. The integration constants γ and p can be written

$$\gamma = \cos\sigma_0/\sqrt{1 - \beta_0^2\sec^2\sigma_0}, \quad p = R\beta_0\tan\sigma_0/\sqrt{1 - \beta_0^2\sec^2\sigma_0}, \qquad (3)$$

where $r_0 = R\sigma_0$ is the shortest distance (perihelion) and $v_0 = c\beta_0$ the velocity of the star at the perihelion, two constants characterizing the individual star. Up to terms of the second order the spectrum shift or the radial velocity V becomes, on developing (1) with (2), (3),

$$V = c\delta\lambda/\lambda = \pm\sqrt{(1 - r_0^2/r^2)(c^2r^2/R^2 + v_0^2)},$$

which is a first-order effect, in r/R as well as in v_0. This holds for any inertial motion, radial or oblique.

With regard to applications of this formula the following remarks were made in the paper. The absolute value of the radial velocity $|V|$ can only be expected to increase *on the whole* with the distance r, this correlation, expressed by the term r/R, being more or less masked by the haphazard distribution of the values of the constants r_0 and v_0 among the celestial objects. In reference to Strömberg's paper (*Mt. Wilson Contributions*, No. 292) and against his statement, the regression-line of $|V|$ on r should by no means pass through the origin of the scatter diagram. Thus in the special case of radial motion ($r_0 = 0$) the effect $|V|$ reduces for vanishing r to v_0 itself and the latter velocity cannot be disregarded but may rather be expected to be on an average of the order of velocities observed on near-by stars. As to the correlation coefficient between $|V|$ and r, it is for the 18 globular clusters, utilized by the writer in 1924 at the Toronto meeting of the British Association and now (l. c.) by Strömberg, rather low though of the right sign, viz. $+0.26$. When the two Magellanic Clouds are added, the correlation coefficient is increased but slightly, to 0.320 ± 0.135. If, however, the two globular clusters, N. G. C. 6205 and 6229, are discarded (not questioning the reliability of their observed data but on the reasonable ground that these clusters may have abnormally high values of v_0 and r_0/r respectively), the remaining 18 objects give the correlation coefficient

$$0.636 \pm 0.095,$$

which is almost seven times its probable error. Many further data, of course, are necessary for a definite solution of this important question. Of the 86 globular clusters for which good distance estimates due to Shapley are available, there remain still 68 awaiting the measurement of their radial velocities. Even a part only of this material, now contemplated by Adams, would greatly help to clinch the question. In the meantime the last quoted coefficient seems to make the existence of the predicted correlation and a curvature radius $R = 6$ to $7 \cdot 10^{12}$ astr. units, as yielded statistically by those eighteen objects, tolerably likely.

THE SOLAR CORONA OF 1925.

By Frederick Slocum.

The path of totality of the 1925 eclipse passed directly over the Van Vleck Observatory, Wesleyan University, Middletown, Connecticut. The duration of totality was 112 seconds. The corona was photographed with cameras ranging from 10 inches to 28 feet in focal length and with exposure times from 2 to 30 seconds. Some of the photographs were made in blue light, using Eastman 40 plates, and others were made in yellow light with Cramer Instantaneous Iso plates and "minus blue" filters.

Lantern slides from the original negatives were shown, illustrating the streamers and extensions of the corona, the polar rays and their asymmetry, arches and reversed curves, the inner corona and prominences. The blue-sensitive and the yellow-sensitive plates apparently show the same detail in the structure of the corona.

ON THE MEAN PARALLAX OF THE COMPARISON STARS USED IN THE DETERMINATION OF TRIGONOMETRIC PARALLAXES.

By P. van de Kamp.

In the photographic determinations of trigonometric parallaxes at the Allegheny, McCormick, Yerkes, Sproul and Dearborn observatories, comparison stars of mean visual magnitude 10 are used. In order to reduce the obtained relative parallaxes to absolute ones, a knowledge of the mean annual parallax of the comparison stars is desirable. Some ten years ago this mean parallax was adopted to be 0″.005. Using more material and making allowance for the effect of galactic latitude, values of 0″.003, 0″.0035, and 0″.004 for the mean parallax of tenth-magnitude stars in the galactic zones $0° \pm 20°$, $\pm 20° \pm 40°$, and $\pm 40° \pm 90°$ are found. (These results are given in *Groningen Publications*, 29, and are used by van Rhijn in *Groningen Publications*, 37, entitled "Comparison between trigonometric, spectroscopic and mean statistical parallaxes.")

Results from proper motions measured on McCormick photographs and of proper motions obtained as a by-product of parallax solutions

at the Allegheny, McCormick, Sproul and Yerkes observatories confirm the mean value of the Groningen parallax for tenth magnitude stars but point toward a stronger dependence on galactic latitude. (These results are described by Alden and van de Kamp in *Astronomical Journal*, No. 843.) The latter result has been strengthened by a discussion of relative photographic proper motions, which is given in *Publications Astronomical Society of the Pacific*, **37**, 276. The combined results of this and the McCormick investigation are given in *Publications Astronomical Society of the Pacific*, **37**, 279. They make the mean parallax of tenth magnitude stars at the poles of the Milky Way 2.34 ± 0.22 times as large as that in the Milky Way; in case of the Groningen values this ratio is only 1.56. In other words, (assuming a sun's velocity of 20 km/sec.) the Groningen values of the mean annual parallax of tenth magnitude stars ranges from 0″.003 in the galactic plane to 0″.005 at the galactic poles, while the new results give 0″.003 and 0″.007 for these quantities.

It appears that the difference is great enough to be considered. More material for a more accurate determination of this dependence on galactic latitude of the parallaxes of faint stars is of course desirable.

Perhaps the larger value of this ratio is of more importance in problems directly concerned with the structure of the universe, but its indirect consequences in the reduction from relative to absolute parallaxes are reason that the following preliminary table was thought worth while to be given:

MEAN ANNUAL PARALLAX OF COMPARISON STARS USED IN THE DETERMINATION OF TRIGONOMETRIC PARALLAXES, ASSUMING A SUN'S VELOCITY OF 20 KM/SEC.

	Galactic Latitude					
	0°	10°	20°	30°	40°	50°
Visual Magnitude = 10	0″.0031	0″.0032	0″.0034	0″.0038	0″.0044	0″.0051
Visual Magnitude = 13	.0008	.0008	.0009	.0010	.0011	.0013

	Galactic Latitude					Groningen Publications
	60°	70°	80°	90°	Mean	**29**
Visual Magnitude = 10	0″.0059	0″.0066	0″.0071	0″.0073	0″.0038	0″.0034
Visual Magnitude = 13	.0015	.0017	.0018	.0018	.0010	.0013

PROPER MOTIONS OF THREE HUNDRED FAINT STARS WHOSE SPECTRA ARE KNOWN FROM THE HENRY DRAPER EXTENSION.

BY A. VYSSOTSKY.

Lewis Morris Rutherford of New York City was one of the pioneers in astronomical photography. He ground his own lenses and constructed his own observatory. His photographs were made by the old wet-plate process with the result that comparatively short exposures only were possible. As is well known, his plates were presented to Columbia University, where they were measured and discussed. Stars down to the eleventh visual magnitude were photographed.

Owing to the great interval of time of more than fifty years the Rutherford plates are now valuable for investigations of proper motions. Four of the regions in Cygnus (η, 27, 34, and γ Cygni) coincide with the area of the recent extension of the Draper Catalogue, with the result that spectral types are known for ninety per cent of the stars on the Rutherford plates in these Cygnus regions.

These same areas have been photographed at the McCormick Observatory during 1925. The McCormick telescope has a focal length three times that of the Rutherford telescope and it was necessary to take five McCormick photographs of each region in order to duplicate the Rutherford areas (one plate in the center and four overlapping plates in the corners). The average probable error of two McCormick plates is $\pm 0''.03$ and of four Rutherford plates $\pm 0''.05$. This gives a probable error for the proper motions of $\pm 0''.001$ in each coördinate.

In the four regions in Cygnus, proper motions have been derived for a total of 323 stars distributed as to spectral class as follows:

Spectral Class	O	B	A	F	G	K	M	O+B +A	F+G+ K+M	Unknown
Number of Stars	3	65	115	34	20	32	7	183	93	47
Mean Magnitude	7.2	9.3	9.6	10.0	9.7	9.0	8.6	9.5	9.5	10.0

From the relative proper motions thus derived a reduction was made to absolute motion by using stars of classes A and B only, and utilizing the formula of van Rhijn in *Groningen Publications*, 29. After applying the correction to absolute motion the average observed residual motion, i. e., the peculiar motion with respect to the mean motion of the group, amounts to $0''.002$ in each coördinate in the case of the faint stars of B type, the largest motion being $0''.009$.

The residual motions of the A stars are also small but they exceed the motions of the B stars. On the contrary the proper motions of the late-type stars (93 stars of F, G, K and M) are on the average rather large and well determined.

The distribution of the directions of the proper motions are shown in three diagrams. The diagram showing all 323 stars when compared with a similar diagram of 118 faint stars drawn by Bruggencate of the Kapteyn Laboratory shows a very close agreement. On account of the small motions of the early-type stars, with the result that the reduction to absolute motions is uncertain, no safe conclusions can be drawn regarding the total motions of these stars. The diagram is symmetrical and may be explained by solar motion only. On the contrary, on account of the larger motions of the late-type stars the diagram showing their motions is not symmetrical and shows the effects of stream motions.

The regions of h and χ Persei are being investigated in a similar manner.

FROM THE DIARY OF A DELEGATE.

By ELEANOR A. LAMSON.

Early in the morning of July 13, 1925, the train from London carried us up to Cambridge and after reporting at the headquarters of The International Astronomical Union in the Arts School, Benét Street, we started out to see a little of this famous college town on the Cam. A kindly official having informed us that where there was an open doorway in a college entrance was permitted, we promptly got lost in the narrow winding streets and the beautiful old courts and buildings dating from the middle ages.

To be lost in Cambridge is a joy to the average American, for failing to find a certain college one is very sure to stumble upon another fully as interesting. As we read our guide books remembering that Bacon, Milton, Tennyson, Macaulay, Thackeray, Isaac Newton and hosts of other worthies lived and studied in these halls, it was with a bit of a start we met an up-to-date college lad hastening to a tennis match. A great place for contrasts is Cambridge!

Desiring to inspect more closely a pleasing fountain in the center of one of the courts I started across the velvet turf, forgetting that only college dignitaries might tread thereon. A roar of "Grass" from a distance brought me to my senses and hastening to the walks I decided that, in the future, field glasses should be used for viewing distant objects surrounded by grass.

When the great doors of King's College Chapel swung open at 5 P. M. we entered the beautiful building and took part in the afternoon service which carried us back to the times of the founders, the Kings Henry VI and Henry VII of England. The sweep of the high roof, the astonishing carvings, the organ screen and stalls, and above all the superb stained glass windows, said to be quite the most beautiful in this section of England, produce a breath-taking picture, never to be forgotten.

Due to the courtesy of the officials of the University, quarters in the colleges were provided for many of the delegates during the days of the Union meetings, and it was my good fortune to be domiciled in Peile Hall at Newnham College, one of the two women's colleges of Cambridge. The buildings of this college surround the great gardens on three sides, the fourth side being open to the tennis courts, athletic field, etc. The grounds are very lovely with trees and shrubbery, flower beds, masses of gorgeous roses, and of course the characteristic velvet-like turf upon which, in this college, we were allowed to walk without fear.

Although it was long vacation time for the regular students, our

hall was occupied by about twenty young school teachers from the rural districts of England who, because of special qualifications, were being given an intensive two-weeks' course in history. The American visitors, for there were three of us at Peile Hall, were allowed the privilege of living in the college and following the general rules prescribed for these students. A most interesting and delightful arrangement, and the gracious hospitality shown us by the authorities of the college is greatly appreciated.

The formal opening of the Union meetings, or the Inaugural Ceremony, took place at 3:00 P. M. July 14 in the Senate House of the University situated in the center of the town. This large hall was crowded with delegates and visitors and scattered through the audience we noticed many familiar faces, our friends from the four quarters of the globe.

A hush fell upon the assembly as Lord Balfour, in the red robes of Chancellor of the University, entered attended by mace bearers. With great dignity and kindliness he welcomed the members of the Union to Cambridge and expressed delight in the international coöperation of astronomers, the tying of the peoples of the earth together for discussion of matters of common interest. He mentioned the great progress made in recent years of the science of astronomy and the generous assistance of public-spirited millionaires who had provided the necessary funds for costly research work.

He then introduced Dr. W. W. Campbell, the President of the Union, who spoke of his satisfaction in seeing this large gathering of astronomers meeting in the great University where the standards of Newton, Adams, and Clerk-Maxwell were so worthily maintained by their successors now living.

Dr. J. H. Jeans, the next speaker, as Secretary of the Royal Society and as President of the Royal Astronomical Society, welcomed the over-sea visitors. He also stressed the value of international coöperation in the pursuit of knowledge. I liked his remark that "no one ever made a fortune out of astronomy," but as he said "it has done far more than its share in providing that vision without which the people perish." He touched upon the researches now being carried on in London and Cambridge as to the ultimate structure of matter. The meeting held in Rome might be called a memorial to Galileo, this one in Cambridge a pilgrimage to the memory of Newton.

The Astronomer Royal, Sir Frank Dyson, reminded the Union that it was the heir of the Solar Union, the conferences on the Carte du Ciel, and those of the Nautical Almanacs and of the Wireless. One of his expressions was quite amusing, speaking of the coöperation of mathematicians, physicists and engineers "as those patient observers who sit up at night and measure photographs and do sums in the morning."

At the close of the Inaugural Ceremony, wearing our identification "Stars" we attended the first of the series of receptions given in honor

of the Union during the Cambridge session. The host on this occasion was the Vice-Chancellor of the University, Professor A. C. Seward, who entertained the members at a delightful garden party at The Master's Lodge, Downing College.

The first business meeting of the General Assembly was held in the large lecture hall of the Arts School July 15 at 10:00 A. M., with President Campbell in the chair. We from Peile Hall sat on benches, somewhat hand-carved by industrious students, well up and back in the theatre where we could see and hear all that was going on. With Dr. Campbell were the General Secretary, Professor Fowler, the vice presidents, interpreters and recorders. The delegates from the several countries were scattered throughout the hall, although those from the United States at this and later sessions generally sat in a more or less compact group in front of us. In such a gathering the value of recorders and interpreters was quite evident since there were two official languages, French and English. Considerable amusement was created when an interpreter would start off in one language and unconsciously pass into the other, only to be brought back to the original by the laughter of his audience.

In a snapshot taken with my small camera at one of the meetings of the General Assembly there may be seen on the blackboard just back of the President the word "Tea" in capital letters. This pleasant function was never overlooked, and the afternoon meetings were so arranged that the members might participate in a typical form of English recreation.

We had received the carefully prepared book of reports of the thirty odd committees comprising the Union. This, which served as a sort of handbook, together with special pamphlets and sheets of agenda, which were distributed to the members, contained the subject matter for discussion at the meetings.

The President in his opening address stated the object of the Union which was organized in Brussels in 1919. This object was the international coöperation of astronomers along many lines of work, as for example the preparation of the Astronomische Gesellschaft Zone Catalogue, the Carte du Ciel, the Parallax and Variation of Latitude programs, etc. He stated his appreciation of the valuable work done by the General Secretary and by the several committees, mentioning in particular that of the committee on the Carte du Ciel, the completion of the work of which the Union had undertaken six years previously.

After the expeditious transaction of much necessary business, the proposals submitted to the General Assembly by the National Committees in an Agenda came up for discussion. The suggestions referring to the adoption of the name "Mean Greenwich Time" for the astronomical time counted from noon, and "Civil Greenwich Time" for that counted from midnight called forth the expression of many varying opinions, some serious and some humorous, from the delegates representing the various countries. This proposal together with two others

relating to the commencement of the Julian Day and the recommendation that astronomers should conform to the new practice of the Nautical Almanacs, counting any given day from midnight to midnight, were finally referred to committees which were to report their conclusions to the Union for final action.

At this meeting the advisability of reorganizing the Committee on Selected Areas under the auspices of the International Union was also discussed together with the work at the Brussels meeting in February, 1925.

In the afternoon we attended the garden party given by Professor and Mrs. Newall and Professor and Miss Eddington at the Cambridge Observatory and Madingley Rise. We entered the Observatory grounds by way of the great gate, and after being welcomed under the portico by our hosts and hostesses, passed into the main building. Here we were shown the clocks, the library, the exhibit of spectrograms, the mural circle, and what was to me the most interesting of all, the famous 8-inch transit circle with which the Cambridge A. G. Zone of $+25°$ to $+30°$ declination was observed. The view from the roof of the building was delightful for we could get a glimpse of the white domes of the equatorials, between the trees, the groups of people scattered about the grounds, the gay little tents and tea tables, and the beautiful walks with box hedges. After inspecting the several instruments in the Observatory grounds, we passed between the box hedges into Madingley Rise where we were graciously received by Mrs. Newall at tea in her lovely English garden.

In the evening the reception tendered the visitors by the Master and Fellows of St. John's College proved to be one of the most brilliant and stately affairs of the week.

The guests were received in the famous Combination Room of the college. The panelled walls of this room, the beautiful "plaster work" ceiling, the great carved fireplace, the portraits, the whole illuminated solely by candle light, made a charming picture. Passing through this lovely room we descended the staircase into rooms where there was an exhibition of Samuel Butler's paintings, and from there into the Great Hall, from the upper end of which we viewed the colorful crowd in "morning or evening" dress about the refreshment tables. We were then shown into the library with its valuable books and manuscripts. Many of these are of great age and quaintness and I wish I could relate some of the tales told of them by our friendly guide. An Irish vellum book of David with illustrations particularly took my fancy since we were informed that it was about 800 years old and the picture of Goliath standing on his head signified that he had been killed!

At the second meeting of the General Assembly in the forenoon of July 16, the recommendation that there be issued at least triennially a printed list of observatories, equipment, principal programs and personnel under the auspices of the Union, was discussed. This proposition, together with the one that there be made a revision of the limits

of the constellations were finally referred to committees for careful consideration. The General Assembly then adjourned to meet the following Tuesday, at which time the committees were to report upon their work.

The next four days were devoted largely to the morning and afternoon sessions of these committees, which were open to the members of the Union and where there was great freedom of discussion.

It should not be understood, however, that all of the time of the delegates was devoted to attendance upon committee meetings, for many interesting social affairs had been arranged for the week by our kind hosts. The receptions at the colleges, the excursion to Ely to see the cathedral, the visit to the Cambridge Instrument Works were all most enjoyable.

One of these interesting social affairs occurred the evening of the seventeenth. This was the reception and garden party given by the President and Fellows of Queen's College. Entering by the old gateway, we passed through a courtyard into a quaint little dressing room where we removed our wraps. Out through stone passageways, worn by the tread of students' feet for hundreds of years, we were welcomed by the President of the College at the entrance to Walnut Tree Court. It seemed as if we had stepped into fairyland, for here and there from the boughs of the great tree were suspended Japanese lanterns, while the paths were bordered on either side with hundreds and hundreds of candles in tiny colored glass vases.

From this court we were conducted through the President's study, the Combination Room and the Dining Room, all exceedingly interesting with beautiful furniture, wall panels, portraits of the two Queens who were the founders of the college, etc. At one place to our joy we could climb a few steps into a sort of cupboard from whence through a small window we looked down into the great dining hall of the students. As our guide remarked this lookout was quite needful for in the old days many of the boys entered college at a very early age and were decidedly scrappy, hence it was well for the Master to keep an eye upon them. The wig room, a small white stone cell where my lord used to powder his wig, was also visited, after which we passed down into the President's beautiful garden.

On the evening of Monday, July 20, at 9:00 P. M. we were invited to a meeting of the Cambridge Philosophical Society held in the lecture theatre of the Botany School. I imagine that pretty nearly all the scientists attended this meeting for two very interesting speeches were delivered (1) "The Structure of Light" by the Master of Trinity College, Sir J. J. Thompson, and (2) "The Internal Constitution of the Stars" by Prof. A. S. Eddington, F. R. S. This was not a business meeting, consequently smoking was allowed and we viewed the proceedings through a soft blue haze while near us a tired scientist went fast asleep.

The next morning, Tuesday, July 21, the General Assembly met in

the Arts School theatre and the several commissions or committees submitted their reports. As a whole these reports were accepted with but little discussion and in *The Transactions*, Vol. II, may be found the interesting details. It was really quite remarkable the large amount of work which had been accomplished during the session of nine days.

The Members of the Union in front of the South Door of the Senate House, July 21, 1925, Cambridge, England.

At the invitation of the Dutch Government (presented by Dr. De Sitter) it was decided that the next meeting of the International Astronomical Union should be held in Holland in 1928.

Tuesday afternoon a very impressive ceremony took place in the Senate House, i. e., the conferring of the Honorary Degree of Doctor of Science upon Dr. Campbell, Dr. Baillaud, Professor De Sitter, Pro-

fessor H. Nagaoka, and Dr. Schlesinger. Each man to be so honored, clad in red robes, was escorted by a mace bearer to the Vice-Chancellor of the University, also in robes of state, while the public orator in sonorous Latin delivered a poetic description of the valuable work accomplished by the candidate. This ceremony was followed by the conferring of degrees upon a number of the undergraduates of the colleges, after which the members of the Union and friends assembled outside the south door of the Senate House for the usual group photograph.

In the evening while the men of the Union were being entertained at dinner by the Master and Fellows of Trinity College, the ladies were dining in Old Hall at Newnham College upon the invitation of the Principal. At the close of dinner we were received by Lady Thompson, the wife of Sir J. J. Thompson, at Trinity College.

A most delightful climax to this meeting of the Astronomical Union in England was the visit to Greenwich Observatory upon the invitation of the Astronomer Royal, Sir Frank Dyson. The occasion was the 250th anniversary of the founding of the observatory, and this, together with the fact that the King and Queen were to be in attendance, the fortunate recipients of invitations made every effort to be present. In London (July 24) we took the early afternoon train for the quaint old town of Greenwich, and by tram proceeded through the town to the foot of the hill upon the top of which the observatory is situated. It seemed as if all the world was wending its way on foot up through Greenwich Park to the walls surrounding the observatory grounds. Just as we entered this park the boys in uniform from the Royal Hospital School, headed by their band, marched up the hill and lined up near the main gateway to the observatory. Armed with our credentials, we were escorted under the ropes to a small door near the great gate, the "needle's eye," and there entered the world-famous Greenwich Observatory.

There were so many interesting things to see as with the crowd we wandered at pleasure through these old rooms, one is rather at a loss as to what of all this wealth to describe. To me the famous old mural circle with which Flamsteed made his historic star observations was most appealing, but best of all and the thing which gave me the greatest thrill was the Meridian Circle swinging in its pit—the Zero Meridian of the World.

The time approached for the arrival of their majesties so we hastened out under the portico facing the main courtyard and not far from the great gate through which the royal party was to enter. It seemed as if we were surrounded by the nations of the earth for we could distinguish our Union friends scattered among the English guests on every hand. At the entrance to the Octagon House were Sir Frank and Lady Dyson with other notables anxiously awaiting the arrival of the royal party, and directly across the courtyard the boys composing the Hospital School band. Suddenly the great gate opened and

in swept the royal automobiles. The King and Queen descended from their car, were welcomed by their hosts and passed into the Octagon House, after which we went through the great garden to the large new building housing the double photographic telescope. After wandering about the lower floor viewing the beautiful exhibit of spectrograms, photographs of comets, the moon, nebulae and so on we climbed the narrow stairway to the big dome. As at Cambridge Observatory, there are two equatorials mounted on one pier, a 30-inch reflector and a 26-inch refractor, and this being an unusual combination to me I viewed it with much interest.

The Visit of the King and Queen to Greenwich Observatory.

With several of our friends we were out on one of the roof platforms, from which the royal standard was displayed, when we saw the royal party coming along the garden walk. It was a very beautiful sight. In the distance the roofs and domes of the observatory showing above the treetops, and nearer, the garden with its tea tent, its crowds of festively attired people who lined the walk as royalty approached our building. As their majesties came up the steps at the entrance they were visible to the huge crowd congregated outside the walls and a great cheer arose. Presently at the narrow doorway opening on our platform appeared the Astronomer Royal followed by the King, Queen, Lady Dyson and several members of the royal party. For a moment they paused, then went on up into the great dome. After a short time Sir Frank Dyson reappeared, and since it had been sprink-

ling in the characteristic English fashion, he held up his hand, then turning to the Queen who had just started down said, "Oh no!" However, she remarked, "Yes, it is!" and walked quite hastily to the entrance at the head of the staircase. The royal party then disappeared down the staircase and in a few moments the great cheer from the crowd outside the wall announced that they were leaving the building. Again we saw them pass through the garden, now on their way to the Octagon House, where they were served tea and where a number of the famous astronomers were presented to them.

Shortly we descended into the garden where tea was served and where we again greeted and bade farewell to our many friends from the four quarters of the globe.

U. S. Naval Observatory, January, 1926.

WINTER MOON.

Brightly the moon like a jewel is beaming,
White in the east, o'er a lone landscape gleaming,
Over the meadows and over the snow,
Glimmering, shimmering, silvery glow.

Low in the east, when the gloaming is ending,
Slowly this white winter moon is ascending,
Looming so large and appearing so nigh,
Satellite framed by a star-spangled sky.

High in the sky, with soft radiance teeming,
Nigh to the time when men, women, are dreaming,
Weird is her splendor on valley and hill,
Cold is her gleam upon river and rill.

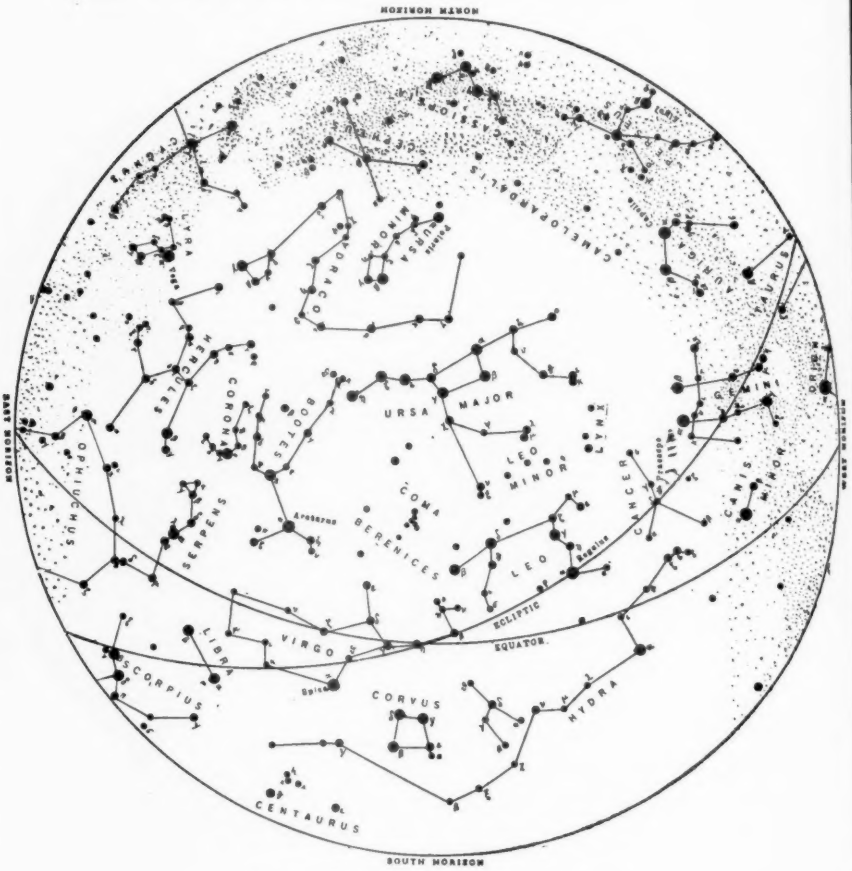
Brightly the moon like a jewel is shining,
White in the west she is slowly declining;
Beautiful Moon! Which beams gorgeous and grand
Over the homes of our own Native Land.

CHARLES NEVERS HOLMES.

18 Pearl Street, Reading, Mass.

PLANET NOTES FOR MAY.

The *Sun* will move northeastward from $2^h\ 30^m$ in right ascension, $+14°\ 47'$ in declination, to $4^h\ 28^m$ in right ascension, $21°\ 46'$ in declination. It will move from the constellation Aries into the constellation Taurus, passing just south of the Pleiades a little after the middle of the month. At the end of the month it will be about 5° due north of Aldebaran.



THE CONSTELLATIONS AT 9:00 P.M. MAY 1.

The phases of the *Moon* will occur as follows:

Last Quarter	May	4	at 9 P.M.	C.S.T.
New Moon		11	" 11 P.M.	"
First Quarter		19	" 12 M.	"
Full Moon		27	" 6 A.M.	"

The moon will be nearest the earth on May 7, and farthest from the earth on May 19.

Mercury having passed a point of greatest elongation west on April 28 will still be visible in the morning sky before sunrise for the first few days in May. It will be west of the sun throughout this month. On May 1 it will cross the meridian at 10:20 A. M., and at the end of the month at 11:35 A. M. It will move eastward from Pisces into Aries. It will not be near any conspicuous star.

Venus will continue to be a brilliant object in the morning sky throughout the month. It will move eastward at practically the same rate as the sun and will be on the meridian a few minutes after 9 A. M. on each day of the month. It will cross the equator from south to north on May 9.

Mars will be visible in the early morning. It will be on the average about 10° south of the equator and will be moving northward slowly. It will move about 20 million miles nearer the earth during this month. Its stellar magnitude will change from +0.8 to +0.4 during the month.

Jupiter will cross the meridian between 6 and 7 A. M. throughout the month of May. It will be south of the equator in the constellation Aquarius.

Saturn will be very favorably situated during this month. It will be near the meridian at midnight. It also will be south of the equator in the constellation Libra.

Uranus may be seen in the eastern sky before sunrise. It will be moving northward. It will be only a little more than 1° south of the equator in the constellation Pisces.

Neptune will be visible in the early evening in the western sky. It will be in the constellation Leo a few degrees west of Regulus.

Saturn's Satellites.

[From the *American Ephemeris.*]

CENTRAL STANDARD TIME, MIDNIGHT = 0^h

I. Mimas. Period 0^d 22^h6.

1926	d	h		d	h		d	h		d	h
May	1	6.3 E	May	8	19.2 E	May	16	19.4 W	May	24	19.6 E
	2	4.9 E		10	5.1 W		18	5.3 E		26	5.5 W
	3	3.5 E		11	3.7 W		19	3.9 E		27	4.1 W
	4	2.1 E		12	2.3 W		20	2.5 E		28	2.7 W
	5	0.7 E		13	0.9 W		21	1.1 E		29	1.3 W
	5	23.3 E		13	23.5 W		21	23.7 E		29	23.9 W
	6	21.9 E		14	22.1 W		22	22.3 E		30	22.5 W
	7	20.6 E		15	20.8 W		23	21.0 E		31	21.2 W

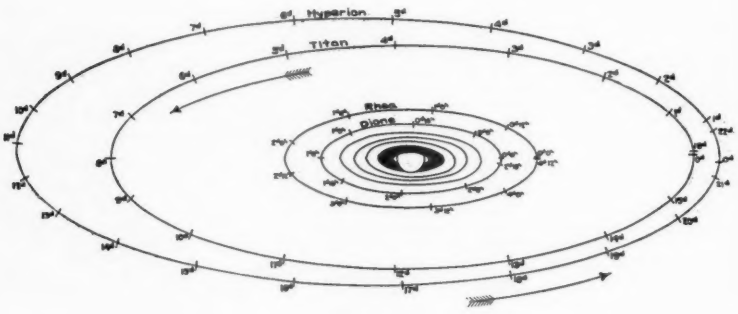
II. Enceladus. Period 1^d 8^h9.

May	0	23.9 E	May	9	5.2 E	May	17	10.4 E	May	25	15.7 E
	2	8.8 E		10	14.1 E		18	19.3 E		27	0.5 E
	3	17.7 E		11	22.9 E		20	4.2 E		28	9.4 E
	5	2.6 E		13	7.8 E		21	13.0 E		29	18.3 E
	6	11.4 E		14	16.7 E		22	21.9 E		31	3.2 E
	7	20.3 E		16	1.6 E		24	6.8 E			

III. Tethys. Period 1^d 21^h3.

May	2	11.6 E	May	10	0.8 E	May	17	13.9 E	May	25	3.1 E
	4	8.9 E		11	22.1 E		19	11.2 E		27	0.4 E
	6	6.2 E		13	19.3 E		21	8.5 E		28	21.6 E
	8	3.5 E		15	16.6 E		23	5.8 E		30	18.9 E

South



North

Apparent orbits of the seven inner satellites of Saturn at date of opposition, May 14, 1926, as seen in an inverting telescope.

IV. Dione. Period $2^d\ 17^h7$.

1926	d	h		d	h	1926	d	h		d	h
May	2	19.4 E	May	11	0.3 E	May	19	5.3 E	May	27	10.2 E
	5	13.0 E		13	18.0 E		21	22.9 E		30	3.9 E
	8	6.7 E		16	11.6 E		24	16.6 E			

V. Rhea. Period $4^d\ 12^h5$.

May	4	19.7 E	May	9	8.0 E	May	18	8.7 E	May	27	9.3 E
				13	20.4 E		22	21.0 E		31	21.6 E

VI. Titan. Period $15^d\ 23^h3$.

May	1	12.9 E	May	9	14.6 W	May	17	10.3 E	May	25	11.9 W

VII. Hyperion. Period $21^d\ 7^h6$.

Ma-	9	0.6 E	May	20	7.7 W	May	30	6.0 E			

VIII. Japetus. Period $79^d\ 22^h1$.

April	29	16.7 W	May	20	5.1 S	June	8	14.4 E			

NOTE—E, Eastern Elongation; W, Western Elongation; S, Superior Conjunction; I, Inferior Conjunction.

Occultations Visible at Washington.

[From the *American Ephemeris.*]

Date 1926	Star's Name	Magnitude	IMMERSION. Washington C.T. h m	IMMERSION. Angle from N °	EMERSION. Washington C.T. h m	EMERSION. Angle from N °	Duration h m
May 1	190 B. Ophiuchi	5.9	1 4	66	2 7	325	1 3
17	139 B. Cancri	6.1	22 42	132	23 34	263	0 53
18	8 Leonis	5.9	21 6	138	22 12	270	1 6
24	80 Virginis	5.6	1 48	124	2 52	281	1 4
27	73 B. Scorpii	6.4	2 25	122	3 36	265	1 10
28	21 G. Sagittarii	5.7	23 4	124	0 16	261	1 11
30	191 B. Sagittarii	6.5	1 48	88	3 10	270	1 22

VARIABLE STARS,

Minima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of minima in 1926							
							May					
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SY Androm.	0 08.0	+43 09	9.5—13.0	34 21.8	3 1							
RT Sculptor.	31.5	—26 13	9.6—10.5	0 12.3	5 2	12 18	20 10	28 2				
U Cephei	0 53.4	+81 20	7.0— 9.0	1 11.8	4 13	12 0	19 12	26 23				
Z Persei	2 33.7	+41 46	9.4—12	3 01.4	5 13	11 16	23 21	30 0				
TW Cassiop.	37.6	+65 19	8.2— 9.0	1 10.3	8 18	17 8	25 22					
RY Persei	39.0	+47 43	8.0—10.3	6 20.7	3 10	10 7	24 0	30 21				
RZ Cassiop.	3.9	+69 13	6.9— 8.1	1 04.7	2 14	9 18	24 3	31 7				
TX Cassiop.	44.4	+62 22	9.4—10.1	2 22.2	4 18	11 12	22 7	31 2				
ST Persei	53.7	+38 47	8.5—10.5	2 15.6	1 15	9 14	17 13	25 11				
RX Cassiop.	2 58.8	+67 11	8.6— 9.1	32 07.6		17 8						
Algol	3 01.7	+40 34	2.3— 3.5	2 20.8	2 21	11 11	20 2	28 16				
RT Persei	16.7	+46 12	9.5—11.5	0 20.4	1 3	7 22	21 12	28 7				
λ Tauri	55.1	+12 12	3.3— 4.2	3 22.9	2 2	10 0	17 22	25 19				
RW Tauri	3 57.8	+27 51	7.1— [11	2 18.5	8 12	16 19	25 3					
RV Persei	4 04.2	+33 59	9.5—11.0	1 23.4	1 8	9 6	17 3	25 1				
RW Persei	13.3	+42 04	8.8—11.0	13 04.8	2 5	15 10	28 15					
SZ Tauri	31.4	+18 20	7.2— 7.7	3 03.6	4 11	10 18	23 8	29 16				
RS Cephei	4 48.6	+80 06	9.5—12.0	12 10.1	6 21	19 7	31 18					
TT Aurigae	5 02.8	+39 27	7.8— 8.7	0 16.0	3 20	9 12	23 19	30 11				
RY Aurigae	11.5	+38 13	10.7—11.7	2 17.5	5 8	13 12	21 17	29 21				
RZ Aurigae	42.9	+31 40	10.6—13.3	3 00.3	1 2	13 3	19 4	31 5				
SV Tauri	45.8	+28 05	9.4—11.0	2 04.0	2 11	11 3	19 19	28 11				
Z Orionis	50.2	+13 40	9.7—10.7	5 04.9	3 12	13 21	24 7					
SV Gemin.	54.6	+24 28	9.8— [11	4 00.2	3 23	12 0	20 0	28 0				
RW Gemin.	5 55.4	+23 08	9.5—11.0	2 20.8	5 16	11 10	22 21	28 14				
U Columbæ	6 11.2	—33 03	9.2—10.0	2 19.2	3 12	9 3	20 7	25 22				
SX Gemin.	22.0	+20 37	10.8—11.5	1 08.8	2 21	11 2	19 7	27 12				
RW Monoc.	29.3	+ 8 54	9.0—10.8	1 21.7	6 6	13 21	21 12	29 3				
RX Gemin.	43.6	+33 21	8.8— 9.6	12 05.0		12 14	24 20	27 2				
RU Monoc.	6 49.4	— 7 28	9.8—10.5	0 21.5	4 18	12 23	20 3	27 7				
R Can. Maj.	7 14.9	—16 12	5.8— 6.4	1 03.3	3 7	10 2	23 17	30 13				
RY Gemin.	21.7	+15 52	8.9— [10	9 07.2		11 2	20 9	29 17				
Y Camelop.	27.6	+76 17	9.5—12	3 07.3	7 14	14 5	20 19	27 10				
TX Gemin.	30.3	+17 08	10.0—11.9	2 19.2	1 1	9 12	17 20	26 6				
RR Puppis	43.5	—41 08	9.4—10.7	6 10.3	5 9	11 20	24 17	31 5				
V Puppis	7 55.4	—48 58	4.1— 4.8	1 10.9	7 2	14 8	21 15	28 21				
X Carinae	8 29.1	—58 53	7.9— 8.7	0 13.0	7 13	15 16	23 19	31 22				
S Cancri	8 38.2	+19 24	8.2—10	9 11.6		10 4	19 16	29 4				
RX Hydrae	9 00.8	— 7 52	9.1—10.5	2 06.8	2 23	9 19	23 12	30 8				
S Velorum	29.4	—44 46	7.8— 9.3	5 22.4	3 23	9 22	21 19	26 17				
Y Leonis	9 31.1	+26 41	9.3—11.2	1 16.5	1 11	8 4	14 23	28 10				
RR Velorum	10 17.8	—41 36	10.0—10.9	1 20.5	2 0	9 10	24 6	31 16				
SS Carinæ	10 54.2	—61 23	12.2—12.8	3 07.2	1 15	8 6	21 11	28 1				
ST Urs. Mai.	11 22.4	+45 44	6.7— 7.2	8 19.2	8 17	17 12	26 7					
RW Urs. Maj.	35.4	+52 34	10.3—11.4	7 07.9	2 3	9 11	24 2	31 10				
Z Draconis	11 39.8	+72 49	9.9—13.6	1 08.6	4 1	10 20	24 10	31 5				
RZ Centauri	12 55.6	—64 05	8.5— 8.9	1 21.0	8 2	15 14	23 2	30 14				
RS Can. Ven.	13 06.3	+36 28	7.5—12.5	4 19.1	9 1	18 15	28 5					
SS Centauri	07.2	—63 37	8.8—10.4	2 11.5	4 3	11 13	19 0	26 10				
SX Hydræ	13 39.0	—26 23	8.6—12.7	2 21.5	6 9	12 4	23 18	29 13				

Minima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of minima in 1926 May							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
δ Libræ	14 55.6	— 8 07	4.8— 6.2	2 07.9	4 5	11 5	18 5	25 4				
U Coronæ	15 14.1	+32 01	7.6— 8.7	3 10.9	4 6	11 3	24 23	31 21				
TW Draconis	15 32.4	+64 14	7.3— 8.9	2 19.4	7 11	15 21	24 7					
SS Libræ	15 43.4	—15 14	9.3—11.5	0 18.4	1 15	8 19	23 4	30 9				
SW Ophiuchi	16 11.1	— 6 44	9.2—10.0	2 10.7	7 6	14 14	21 22	29 6				
SX Ophiuchi	12.6	— 6 25	10.5—11.2	2 01.5	7 9	15 15	23 21					
R Aræ	31.1	—56 48	6.8— 7.9	4 10.2	1 3	9 23	18 20	27 16				
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1		13 23						
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	2 1	8 21	22 11	29 6				
U Ophiuchi	11.5	+ 1 19	6.0— 6.7	0 20.1	1 15	10 1	18 10	26 19				
u Herculis	13.6	+33 12	4.6— 5.4	2 01.2	4 11	10 15	22 22	29 2				
TX Herculis	15.4	+42 00	8.3— 9.0	1 00.7	2 12	8 16	21 1	27 5				
RV Ophiuchi	29.8	+ 7 19	9. —12	3 16.5	3 11	10 20	18 5	25 14				
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	4 16	12 20	21 1	29 5				
TX Scorpii	48.6	—34 13	7.5— 8.2	0 22.6	3 15	11 4	18 17	26 6				
UX Herculis	49.7	+16 57	8.8—10.5	1 13.2	2 3	9 21	17 15	25 9				
Z Herculis	53 6	+15 09	7.1— 7.9	3 23.8	1 23	9 23	17 23	25 22				
WX Sagittarii	53.6	—17 24	9.2—10.8	2 03.1	4 11	13 0	21 12	30 1				
WY Sagittarii	17 54.9	—23 01	9.5—10.6	4 16.0	2 11	11 20	21 4	30 12				
SX Draconis	18 03.0	+58 23	9.3—10.5	5 04.1	2 23	13 7	18 11	28 19				
RS Sagittarii	11.0	—34 08	5.9— 6.3	2 10.0	2 2	9 8	23 20	31 2				
V Serpentis	11.1	—15 34	9.5—11.1	3 10.9	3 1	9 22	23 18	30 16				
RZ Scuti	21.1	— 9 15	7.4— 8.3	15 03.2		12 14	27 17					
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	1 23	9 3	23 11	30 15				
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3	3 2	10 5	24 10	31 13				
SX Sagittarii	39.7	—30 36	8.7— 9.8	2 01.8	8 22	17 5	25 12					
RR Draconis	40 8	+62 34	9.3—13	2 19.9	1 5	9 16	18 4	26 16				
RS Scuti	43.7	—10 21	9.3—10.3	0 15.9	3 13	10 5	23 12	30 3				
β Lyræ	46.4	+33 15	3.4— 4.1	12 21.8	3 11	16 9	29 7					
U Scuti	18 48.9	—12 44	9.1 9.6	0 22.9	2 11	10 2	17 18	25 9				
RX Draconis	19 01.1	+58 35	9.5—10.2	1 21.4	4 5	11 18	19 8	26 22				
RV Lyræ	12.5	+32 15	11. —12.8	3 14.4	5 22	13 3	20 8	27 12				
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	1 1	9 23	18 22	27 21				
U Sagittæ	14.4	+19 26	6.5— 9.0	3 09.1	3 5	10 0	23 12	30 7				
Z Vulpec.	17.5	+25 23	7.3— 8.5	2 10.9	3 3	10 12	17 20	25 5				
TT Lyræ	24.3	+41 30	9.4—11.6	5 05.8	5 17	16 4	21 10	31 22				
UZ Draconis	26.1	+68 44	9.0— 9.8	1 15.1	6 19	13 8	19 20	26 9				
SY Cygni	19 42.7	+32 28	10. —12	6 00.2	2 10	8 10	20 10	26 10				
WW Cygni	20 00.6	+41 18	9.3—13.4	3 07.6	6 10	13 1	19 16	26 7				
SW Cygni	03.8	+46 01	9. —11.7	4 13.8	1 10	10 14	19 17	28 21				
VW Cygni	11.4	+34 12	9.8—11.8	8 10.3	8 14	17 0	25 10					
RW Capric.	12.2	—17 59	8.8—10.6	3 09.4	1 5	8 0	21 14	28 9				
UW Cygni	19.6	+42 55	10.5—13	3 10.8	2 23	9 21	23 16	30 14				
V Vulpec.	32.3	+26 15	8.2— 9.8	37 19.0		14 3						
W Delphini	33.1	+17 56	9.4—12.1	4 19.4	2 6	11 21	21 11	31 2				
RR Delphini	38 9	+13 35	10.5—11.8	4 14.4	1 1	10 6	19 11	28 16				
Y Cygni	48.1	+34 17	7.1— 7.9	1 12.0	9 6	18 6	27 5					
WZ Cygni	49.3	+38 27	9.9—10.8	0 14.0	7 6	14 20	22 11	30 1				
RR Vulpec.	20 50.5	+27 32	9.6—11.0	5 01.2	1 9	11 11	21 14	31 16				
RY Aquarii	21 14.8	—11 14	8.8—10.4	1 23.2	6 22	14 19	22 16	30 13				
UZ Cygni	55.2	+43 52	8.9—11.6	31 07.3				30 5				
RT Lacertæ	21 57.4	+43 24	9.1—10.5	5 01.7	3 14	13 18	18 20	28 23				
RW Lacertæ	22 40.6	+49 08	10.2—11.2	5 04.4	5 6	15 15	20 19	30 4				
VW Pegasi	51.7	+32 42	10.0—10.6	5 06.4	3 0	12 13	17 20	28 8				
Y Piscium	23 29.3	+ 7 22	9.0—12.0	3 18.4	5 2	12 15	20 4	27 16				
TW Androm.	23 58.2	+32 17	8.6—11.5	4 02.9	8 21	17 3	25 8					

Maxima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of maxima in 1926							
					May							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SX Cassiop.	0 05.5	+54 20	8.6— 9.2	36 13.7	5 9							
SY Cassiop.	0 09.8	+57 52	9.3— 9.9	4 01.7	1 9		9 12		17 16		25 19	
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	3 7		11 1		18 18		26 12	
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2	4 14				19 10			
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	5 8		13 6		21 5		29 4	
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	5 3		12 22		20 17		28 12	
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0			12 8				28 18	
SX Persei	4 10.2	+41 27	10.4—11.2	4 07.0	5 11		14 1		22 14		31 4	
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1	5 23		17 2		28 5			
RX Aurigæ	4 54.5	+39 49	7.2— 8.1	11 15.0	4 18		16 9		28 1			
SX Aurigæ	5 04.6	+42 02	8.0— 8.7	1 12.8	4 1		11 17		19 9		27 1	
SY Aurigæ	05.5	+42 41	8.4— 9.5	10 03.3			10 3		20 7		30 10	
Y Aurigæ	21.5	+42 21	8.6— 9.6	3 20.6	1 8		9 1		16 19		24 12	
RZ Gemin.	5 56.6	+22 15	9.1—10.0	5 12.7	3 12		14 13		20 2		31 3	
RS Orionis	6 16.5	+14 44	8.2— 8.9	7 13.6	2 14		10 3		17 17		25 7	
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3	16 7							
RT Aurigæ	23.0	+30 33	5.1— 6.0	3 17.5	1 13		9 0		16 11		23 22	
W Gemin.	29.2	+15 24	6.7— 7.5	7 22.0	6 4		14 2		22 0		29 22	
ζ Gemin.	6 58.2	+20 43	3.7— 4.3	10 03.7	5 0		15 4		25 7			
RU Camelop.	7 10.9	+69 51	8.5— 9.8	22 06.5					21 20			
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	6 10		14 9		22 7		30 6	
V Carinae	8 26.7	—59 47	7.4— 8.1	6 16.7	5 11		12 3		18 20		25 12	
T Velorum	8 34.4	—47 01	7.6— 8.5	4 15.3	4 8		13 15		18 6		27 13	
V Velorum	9 19.2	—55 32	7.5— 8.2	4 08.9	2 3		10 21		19 15		28 8	
Z Leonis	9 46.4	+27 22	7.9— 9.6	56 08.7			18 15					
RR Leonis	10 02.1	+24 29	9.1—10.1	0 10.9	1 5		8 1		21 14		28 9	
SU Draconis	11 32.2	+67 53	8.9— 9.6	0 15.8	6 5		12 20		19 10		26 1	
S Muscae	12 07.4	—69 36	6.4— 7.3	9 15.8	2 9		12 1		21 17		31 9	
SW Draconis	12.8	+70 04	8.8— 9.6	0 13.7	6 17		14 16		22 16		30 15	
T Crucis	15.9	—61 44	6.8— 7.6	6 17.6	6 10		13 4		19 22		26 16	
R Crucis	18.1	—61 04	6.8— 7.9	5 19.8	2 21		8 17		20 9		26 5	
S Crucis	12 48.4	—57 53	6.5— 7.6	4 16.6	1 0		10 9		19 19		29 3	
W Virginis	13 20.9	— 2 52	8.7—10.4	17 06.5	7 2		24 8					
SS Hydræ	25.0	—23 08	7.4— 8.1	8 04.8	8 12		16 17		24 23			
RV Urs. Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	1 2		8 2		22 3		29 4	
ST Virginis	14 22.5	— 0 27	10.3—11.4	0 09.9	5 15		13 1		20 10		27 20	
V Centauri	25.4	—56 27	6.4— 7.8	5 11.9	4 10		15 10		20 21		31 21	
R3 Bootis	29.3	+32 11	8.9—10.0	0 09.1	8 0		15 12		23 2		30 15	
R Triang.Austr.	15 10.8	—66 08	6.7— 7.4	3 09.3	4 23		11 17		18 12		25 6	
S Triang.Austr.	15 52.2	—63 29	6.4— 7.4	6 07.8	5 8		11 16		24 7		30 15	
S Normæ	16 10.6	—57 39	6.6— 7.6	9 18.1	9 22		19 16		29 10			
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	9 9		18 6		27 2			
RV Scorpii	16 51.8	—33 27	6.7— 7.4	6 01.5	5 5		11 6		23 9		29 11	
X Sagittarii	17 41.3	—27 48	4.4— 5.0	7 00.3	4 16		11 16		18 17		25 17	
Y Ophiuchi	47.3	— 6 07	6.1— 6.5	17 02.9			15 6					
W Sagittarii	17 58.6	—29 35	4.3— 5.1	7 14.3	2 21		10 11		18 1		25 15	
Y Sagittarii	18 15.5	—18 54	5.4— 6.2	5 18.6	1 23		13 12		19 7		30 20	
U Sagittarii	26.0	—19 12	6.5— 7.3	6 17.9	5 9		12 3		18 21		25 15	
Y Scuti	32.6	— 8 27	8.7— 9.2	10 08.3			11 2		21 11		31 19	
RZ Lyræ	39.9	+32 42	9.9—11.2	0 12.3	3 17		11 9		19 1		26 17	
RT Scuti	18 44.1	—10 30	9.1— 9.7	0 11.9	7 18		15 5		22 15		30 2	
κ Pavonis	18 46.6	—67 22	3.8— 5.2	9 02.2	3 19		12 22		22 0		31 2	
U Aquilæ	19 24.0	— 7 15	6.2— 6.9	7 00.6	4 0		11 1		18 1		25 2	

Maxima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of maxima in 1926 May							
	h m	° ′		d h	d h	d h	d h	d h				
XZ Cygni	19 30.4	+56 10	8.6— 9.3	0 11.2	3 5	10 5	24 5	31 5				
U Vulpec.	32.2	+20 07	6.5 - 7.6	7 23.5	2 15	10 14	18 14	26 13				
SU Cygni	40.8	+29 01	6.2— 7.0	3 20.3	4 8	12 1	19 17	27 9				
η Aquilæ	47.4	+ 0 45	3.7— 4.5	7 04.2	1 20	9 1	23 8	30 12				
S Sagittæ	51.5	+16 22	5.6— 6.4	8 09.2	4 14	12 23	21 8	29 17				
X Vulpec.	19 53.3	+26 17	9.5—10.5	6 07.7	6 22	13 6	19 14	25 21				
X Cygni	20 39.5	+35 14	6.0— 7.0	16 09.3	7 3		23 12					
T Vulpec.	47.2	+27 52	5.5— 6.1	4 10.5	1 15	10 11	19 8	28 5				
UY Cygni	52.3	+30 03	9.6—10.4	0 13.5	8 1	15 8	22 15	29 21				
RV Capric.	55.9	—15 37	9.2—10.1	0 10.7	4 4	11 8	18 11	25 15				
TX Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4	9 12	24 5						
VY Cygni	21 00.4	+39 34	8.8— 9.5	7 20.6	3 9	11 6	19 3	26 23				
SW Aquarii	10.2	— 0 20	9.9—10.8	0 11.0	6 16	13 13	20 10	27 8				
VZ Cygni	21 47.7	+42 40	8.2— 9.2	4 20.7	4 8	14 2	18 2	28 16				
Y Lacertæ	22 05.2	+50 33	9.1— 9.6	4 07.8	4 17	13 9	22 1	30 16				
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	4 12	15 6	20 14	31 8				
Z Lacertæ	36.9	+56 18	8.2— 9.0	10 21.1	4 6	15 4	26 1					
RR Lacertæ	37.5	+55 55	8.5— 9.2	6 10.1	5 8	11 18	24 14	31 0				
V Lacertæ	44.5	+55 48	8.5— 9.5	4 23.6	4 15	14 14	19 14	29 13				
X Lacertæ	22 45.0	+55 54	8.2— 8.6	5 10.7	4 4	15 1	20 12	31 9				
SW Cassiop.	23 03.7	+58 11	9.2— 9.7	5 10.6	6 8	11 19	22 16	28 2				
RS Cassiop	32.6	+61 52	9.0—11.0	6 07.1	1 12	7 19	20 9	26 16				
RY Cassiop.	47.2	+58 11	9.3—11.8	12 03.4		12 14	24 17					
V Cephei	23 51.7	+82 38	6.0— 7.0	0 23.9	2 20	9 20	23 19	30 19				

RZ Eridani. — Observers possessing unpublished material concerning this star are requested to send it to the Cracow Observatory, where a general reduction and discussion of observations of RZ Eridani has been undertaken. Both visual and photographic estimates of brightness are welcomed, not excluding those of full light. (*Acta Astronomica*, 1925 Dec. 8.)

Monthly Report of the American Association of Voriable Star Observers, February, 1926.

This report, as is usual for this season of the year, is considerably reduced quantity, but not in quality. The average has been nearly four observations per star; not an insufficient number, if they were well distributed among all the variables.

SU Tauri, 054319, is apparently on the rise to maximum, having remained below magnitude 13 for more than two months. SS Aurigae, 060547, was again at maximum early in February, having been observed as magnitude 11.3 by Mr. Waterfield on Feb. 6, while the day before two observers found it fainter than the 13th magnitude. We welcome observations this month from such former contributors as Messrs. Hama, Perrot, Macaughey and Proctor.

The Annual Spring Meeting will, at the kind invitation of Professor Harriet W. Bigelow, be held at the Smith College Observatory, Northampton, Mass., on May 29. This convenient location, together with the excellence of the atsronomical equipment there to be found, should result in the gathering together of many of our members, not only from the East, but we hope from the Middle and Farther West.

Variable Star Observations Received During February, 1926.

Dec. 0 = J.D. 2424485; Jan. 0 = J.D. 2424516; Feb. 0 = J.D. 2424547.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
000339 V Sculptoris—						
	4499.0	[13.3	Bl			
001032 S Sculptoris—						
	4497.0	7.0	Bl	4529.3	8.2	Sm
	4507.0	7.8	Bl	4547.3	9.1	Sm
	4523.3	7.9	Sm			
001046 X Andromedae—						
	4534.1	[11.1	Ch	4548.5	13.7	B
	4545.5	13.5	Bi	4553.7	13.8	Wf
001620 T Ceti—						
	4522.2	5.5	L			
001726 T Andromedae—						
	4548.5	13.9	B			
001755 T Cassiopeiae—						
	4525.3	7.7	L	4554.6	7.5	Jo
	4529.2	8.4	Ch	4554.7	7.1	Sg
	4534.5	7.5	B	4557.6	7.2	Pt
	4552.5	7.6	B			
001838 R Andromedae—						
	4407.0	11.2	H	4533.6	14.8	Wf
	4504.1	14.3	Wf	4553.7	14.6	Wf
001862 S Tucanae—						
	4499.0	[13.5	Bl	4533.4	11.0	Sm
	4523.4	[12.5	Sm			
001900 S Ceti—						
	4522.2	13.2	L			
002546 T Phoenicis—						
	4497.0	10.5	Bl	4526.3	12.0	Sm
	4507.0	11.1	Bl	4531.3	12.2	Sm
	4521.3	11.8	Sm	4547.3	[12.2	Sm
002833 W Sculptoris—						
	4499.0	13.0	Bl			
003179 Y Cephei—						
	4535.5	10.8	Ie			
004047 U Cassiopeiae—						
	4550.6	[13.0	Lv	4553.7	[15.0	Wf
004132 RW Andromedae—						
	4529.2	9.7	Ch	4554.6	8.1	Cu
	4535.5	9.0	B	4557.6	8.0	Pt
004435 X Sculptoris—						
	4497.0	12.1	Bl			
004435 V Andromedae—						
	4545.6	[13.5	Bi	4549.5	[13.5	B
004533 RR Andromedae—						
	4553.7	[14.0	Wf	4548.5	[13.5	B
004746a RV Cassiopeiae—						
	4553.7	15.0	Wf	4549.5	14.3	B
004746b — Cassiopeiae—						
	4557.6	10.8	Pt			
004958 W Cassiopeiae—						
	4550.5	11.3	B	4557.6	12.4	Pt
005475 U Tucanae—						
	4499.0	13.5	Bl	4531.4	12.0	Sm
	4507.0	13.4	Bl	4547.3	11.2	Sm
	4521.3	12.9	Sm	4526.4	12.5	Sm
005840 RT Andromedae—						
	4538.5	[11.0	Pt	4557.6	[12.4	Pt
	4539.5	[11.0	Pt	4558.5	[13.0	Cu
	4540.5	[11.0	Pt	4558.6	[12.6	Pt
	4541.5	[11.7	Pt	4563.5	13.0	Pt
	4544.5	10.9	Pt	4567.5	12.2	Cu
	4545.5	10.9	Pt	4568.5	10.7	Cu
	4546.5	10.7	Pt	4570.5	11.0	Cu
	4554.5	13.8	Cu			
010102 Z Ceti—						
	4548.5	12.9	B	4557.6	13.3	Pt
010564 RU Cassiopeiae—						
	4542.9	6.0	H	4543.9	5.9	H
010630 U Sculptoris—						
	4499.0	12.8	Bl			
010940 U Andromedae—						
	4535.5	12.9	B	4553.7	11.9	Wf
	4548.6	12.2	B	4554.6	11.8	Cu
	4551.5	11.9	B	4555.5	11.8	B
011041 UZ Andromedae—						
	4548.5	14.3	B	4553.7	14.8	Wf
011208 S Piscium—						
	4549.6	10.4	B			
011272 S Cassiopeiae—						
	4534.1	[11.9	Ch	4553.7	14.6	Wf
	4535.6	14.3	Wf	4563.6	[13.2	Ie
	4545.5	[13.2	Bi			
011712 U Piscium—						
	4557.6	12.0	Pt			
012350 RZ Persei—						
	4550.5	10.6	B			
012502 R Piscium—						
	4531.0	11.6	Ch	4550.6	8.2	Lv
	4542.6	9.5	Lv	4557.5	8.0	Bi
013238 RW Andromedae—						
	4519.1	[10.3	Ch	4552.6	10.8	B
	4534.1	10.3	Ch	4553.7	10.5	Wf
	4534.5	10.9	B	4557.6	11.0	Pt
013338 Y Andromedae—						
	4519.1	9.0	Ch	4534.5	8.6	B
	4526.2	8.6	Ch	4552.5	8.9	B
	4534.1	8.7	Ch	4557.6	9.1	Pt
014958 X Cassiopeiae—						
	4534.5	10.2	B	4557.6	11.7	Pt
	4550.5	11.3	B			
015023 RR Arietis—						
	4529.0	6.1	H	4539.0	6.2	H
	4530.0	6.2	H	4542.9	5.8	H
	4531.0	5.8	H	4543.0	5.8	H
	4534.0	6.0	H	4544.9	5.8	H
	4537.0	6.0	H			
015254 U Persei—						
	4526.2	9.9	Ch	4556.5	9.7	B
	4534.2	10.0	Ch	4557.6	9.5	Pt
	4535.6	10.0	B	4557.7	9.5	Sg
021024 R Arietis—						
	4526.2	9.3	Ch	4553.7	11.0	Wf
	4531.2	9.7	Ch	4556.5	12.7	B
	4535.2	10.0	Ch	4557.6	11.3	Bi

VARIABLE STAR OBSERVATIONS RECEIVED DURING FEBRUARY, 1926—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
021024 R ARIETIS—Continued.						
	4535.6	9.4	B	4557.6	11.9	Pt
	4542.6	10.0	Lv	4563.7	12.0	Cy
	4553.6	10.9	Lv			
021143a W ANDROMEDAE—						
	4520.2	7.0	Ch	4535.6	7.5	B
	4529.2	7.1	Ch	4553.7	7.7	Wf
	4533.2	7.0	Ch	4557.6	8.0	Pt
	4535.2	7.0	Ch	4560.6	7.8	B
021258 T PERSEI—						
	4526.2	8.9	Ch	4557.6	8.6	Pt
021281 Z CEPHEI—						
	4535.6	[13.5	Ie	4555.6	13.0	Wf
	4555.6	13.1	Ie	4557.6	12.4	Pt
021403 o CETI—						
	4506.1	3.7	Wf	4534.6	4.6	Wf
	4519.1	4.0	Ch	4535.2	4.3	Ch
	4521.4	3.6	Sm	4535.6	4.2	Cy
	4522.2	3.7	L	4538.6	4.3	Cy
	4523.2	4.2	Pe	4544.4	4.2	L
	4524.1	4.0	Ch	4548.7	3.9	Mc
	4524.2	4.2	Pe	4549.7	4.2	Mc
	4525.2	4.1	Pe	4551.7	4.2	Mc
	4526.2	4.2	Pe	4552.6	5.6	Cy
	4526.3	3.8	Sm	4552.7	4.5	Mc
	4527.2	4.1	Ch	4557.6	5.0	Pt
	4530.2	4.1	Ch	4558.6	5.2	Cy
	4533.0	4.1	Ch	4563.5	5.8	Cy
	4533.3	4.0	Sm			
021558 S PERSEI—						
	4526.2	9.6	Ch	4557.6	9.4	Pt
	4535.6	9.4	B	4560.6	9.6	B
022000 R CETI—						
	4530.2	8.5	Ch			
022150 RR PERSEI—						
	4534.2	[10.4	Ch			
022426 R FORNACIS—						
	4497.0	9.5	Bl	4507.0	9.6	Bl
022813 U CETI—						
	4519.1	8.8	Ch	4557.6	8.3	Pt
	4530.2	8.6	Ch			
023980 RR CEPHEI—						
	4555.6	[13.6	Ie			
023133 R TRIANGULI—						
	4526.2	11.4	Ch	4557.6	10.5	Bi
	4542.6	11.3	Lv	4557.6	10.4	Pt
	4553.6	11.0	Lv	4558.6	10.3	Cy
	4554.6	9.8	Jo	4560.6	10.8	B
024356 W PERSEI—						
	4534.2	9.4	Ch	4556.6	7.3	B
	4535.6	9.7	Cy	4557.6	9.1	Pt
	4535.6	9.1	B	4558.6	9.6	Cy
	4539.6	9.8	Cy			
025050 R HOROLOGII—						
	4497.0	6.8	Bl	4523.4	7.4	Sm
	4507.0	7.4	Bl	4530.4	7.3	Sm
025751 T HOROLOGII—						
	4499.0	12.4	Bl	4523.4	10.2	Sm
	4507.0	12.1	Bl	4533.3	9.7	Sm
031401 X CETI—						
	4522.2	9.7	L	4557.6	9.4	Pt
	4544.4	9.1	L			
032043 Y PERSEI—						
	4534.2	9.2	Ch	4560.6	9.2	B
	4557.6	8.1	Pt			
032335 R PERSEI—						
	4548.6	9.4	B	4557.6	9.0	Pt
	4553.8	9.2	Wf			
032443 NOVA PERSEI, 1918—						
	4554.6	13.6	Cu			
041619 T TAURI—						
	4554.5	10.5	Cu	4559.7	10.5	Cu
	4555.7	10.5	Cu	4567.6	10.7	Cu
	4558.6	10.4	Cu	4570.6	10.7	Cu
042209 R TAURI—						
	4526.0	[10.6	Ch	4557.6	9.0	Pt
	4552.5	9.0	Ie	4560.6	9.0	B
042215 W TAURI—						
	4535.6	11.3	Cy	4557.6	10.0	Pt
	4535.6	10.6	B	4558.6	10.0	Cy
	4554.7	11.1	Sg	4559.6	9.7	B
042309 S TAURI—						
	4526.0	[10.6	Ch	4560.6	[14.1	B
	4552.5	[13.0	Ie			
043065 T CAMELOPARDALIS—						
	4523.3	13.7	L	4557.6	13.5	Pt
043208 RX TAURI—						
	4542.6	10.1	Lv	4557.6	10.2	Pt
	4550.6	10.2	Lv	4559.6	10.3	B
	4553.6	9.7	Lv			
043263 R RETICULI—						
	4497.0	10.8	Bl	4523.4	12.0	Sm
	4507.0	10.9	Bl	4533.3	12.5	Sm
043274 X CAMELOPARDALIS—						
	4531.1	8.3	Ch	4555.6	8.4	Ie
	4552.6	8.1	B	4557.6	8.5	Pt
043562 R DORADUS—						
	4497.0	5.2	Bl	4523.4	5.5	Sm
	4507.0	5.4	Bl	4533.3	5.5	Sm
043738 R CAELI—						
	4499.0	[12.5	Bl			
044349 R PICTORIS—						
	4497.0	8.0	Bl	4507.0	8.0	Bl
044617 V TAURI—						
	4532.0	12.3	Ch	4548.6	11.1	B
	4533.5	12.0	Wf			
045307 R ORIONIS—						
	4536.6	11.0	B	4563.6	11.9	B
045514 R LEPORIS—						
	4523.3	9.1	L	4557.6	8.0	Pt
	4524.1	9.4	Ch	4557.7	8.8	Mb
	4536.3	8.3	L	4563.6	8.3	B
	4536.6	8.6	B			
050003 V ORIONIS—						
	4552.6	13.6	B	4557.6	13.5	Pt
050022 T LEPORIS—						
	4497.0	8.2	Bl	4556.6	8.7	B
	4507.0	8.5	Bl	4557.6	8.4	Pt

VARIABLE STAR OBSERVATIONS RECEIVED DURING FEBRUARY, 1926—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
050848 S PICTORIS—						
	4499.0	13.7	Bl	4552.6	13.6	B
	4507.0	[12.9	Bl	4563.7	[13.0	B
	4527.4	[12.9	Sm			
050953 R AURIGAE—						
	4535.7	12.8	Wf	4557.6	13.6	Pt
051247 T PICTORIS—						
	4497.0	12.2	Bl	4527.4	[12.5	Sm
051533 T COLUMBAE—						
	4497.0	10.0	Bl	4521.3	8.7	Sm
	4507.0	9.3	Bl			
052034 S AURIGAE—						
	4532.1	8.7	Ch	4557.6	8.4	Pt
	4554.7	8.5	Sg			
052036 W AURIGAE—						
	4532.1	10.0	Ch	4560.6	10.3	B
	4557.6	10.4	Pt			
052404 S ORIONIS—						
	4535.6	9.4	B	4560.7	9.6	B
	4557.6	9.2	Pt			
*053005*a T ORIONIS—						
	4522.2	10.8	L	4548.6	10.4	B
	4524.3	10.9	L	4552.7	9.9	Cu
	4525.3	10.8	L	4554.5	10.1	Cu
	4536.3	10.4	L	4555.5	10.2	B
	4536.6	9.4	B	4555.7	10.2	Cu
	4538.5	11.0	Pt	4557.6	10.2	Pt
	4539.5	11.0	Pt	4558.6	10.4	Pt
	4540.5	10.5	Pt	4558.7	9.9	Cu
	4541.5	10.5	Pt	4559.7	10.0	Cu
	4544.5	10.6	Pt	4563.5	10.0	Pt
	4545.5	10.4	Pt	4570.6	10.2	Cu
	4546.5	10.2	Pt			
053068 S CAMELOPARDALIS—						
	4533.2	10.0	Ch	4557.6	9.7	Pt
053326 RR TAURI—						
	4559.7	12.9	B			
053337 RU AURIGAE—						
	4554.7	[11.7	Sg	4557.6	[12.4	Pt
053531 U AURIGAE—						
	4532.1	12.2	Ch	4559.7	12.9	B
	4557.6	12.4	Pt			
054319 SU TAURI—						
	4524.3	[10.5	L	4552.6	[12.9	Ie
	4525.1	[11.5	Ch	4552.7	[12.3	Cu
	4532.1	[12.1	Ch	4553.6	[13.1	Lv
	4533.5	14.7	Wf	4553.7	[14.4	Wf
	4534.6	15.0	Wf	4554.6	[13.2	Cu
	4535.0	[11.5	Ch	4555.7	[13.2	Cu
	4536.3	[12.9	L	4557.6	[13.0	Bi
	4538.5	[11.3	Pt	4557.6	[12.1	Pt
	4541.5	[11.1	Pt	4558.5	[12.9	Ie
	4542.6	[12.9	Lv	4558.7	[12.9	Cu
	4544.5	[11.3	Pt	4558.3	[12.1	Pt
	4545.5	[12.1	Pt	4559.7	[12.9	Cu
	4545.6	[12.7	Bi	4563.5	[13.0	Pt
	4546.5	[12.1	Pt	4563.6	[12.9	Ie
	4551.6	[13.5	B	4570.6	[12.3	Cu
054331 S COLUMBAE—						
	4499.0	13.0	Bl	4507.0	12.6	Bl
	4521.3	12.2	Sm	4526.3	11.7	Sm
054615a Z TAURI—						
	4552.5	13.8	Ie			
054615c RU TAURI—						
	4552.5	14.0	Ie			
054629 R COLUMBAE—						
	4499.0	[13.0	Bl	4521.3	[13.0	Sm
054920a U ORIONIS—						
	4532.1	10.6	Ch	4553.6	11.5	Lv
	4535.0	10.6	Ch	4557.6	11.5	Pt
	4552.6	11.3	Cy	4563.6	11.0	B
054920b UW ORIONIS—						
	4552.6	10.6	Cy	4557.6	10.2	Bi
	4553.6	10.9	Lv	4558.6	10.3	Cy
054974 V CAMELOPARDALIS—						
	4504.1	10.8	Wf	4555.5	10.2	B
	4533.2	10.0	Ch	4555.8	11.1	Cu
	4555.5	11.0	Ie	4557.6	10.5	Pt
055353 Z AURIGAE—						
	4532.1	10.7	Ch	4557.6	10.3	Pt
	4538.5	11.0	Pt	4558.6	10.6	Pt
	4541.5	11.0	Pt	4558.7	10.5	Cu
	4544.5	11.0	Pt	4562.9	9.9	Pt
	4545.5	10.8	Pt	4563.5	9.7	Pt
	4554.7	10.6	Cu	4570.6	9.7	Cu
	4555.5	10.5	B			
055686 R OCTANTIS—						
	4497.0	11.2	Bl	4529.3	8.9	Sm
	4523.3	9.6	Sm			
060450 X AURIGAE—						
	4525.1	11.5	Ch	4535.0	10.4	Ch
	4532.0	10.8	Ch	4557.6	8.8	Pt
	4534.2	10.4	Ch	4559.7	8.8	B
060547 SS AURIGAE—						
	4504.1	[14.5	Wf	4552.5	[13.0	Cy
	4522.2	13.4	L	4552.7	[13.3	Cu
	4524.2	14.5	L	4553.7	11.3	Wf
	4524.2	[11.6	Ch	4554.6	11.0	Cu
	4525.1	[11.6	Ch	4554.7	10.8	Sg
	4525.3	14.5	L	4555.5	11.3	Ie
	4529.1	[11.6	Ch	4555.5	11.3	B
	4532.0	[11.6	Ch	4555.6	11.9	Wf
	4533.0	[11.6	Ch	4555.7	11.3	Cu
	4533.6	[12.4	Wf	4556.6	11.7	B
	4534.2	[11.6	Ch	4557.6	12.0	Bi
	4534.6	15.4	Wf	4557.6	12.3	Pt
	4535.0	[11.6	Ch	4557.8	12.4	Sg
	4535.6	[14.5	Wf	4558.5	13.0	Ie
	4536.3	[12.4	L	4558.6	13.0	B
	4536.6	[13.0	Cy	4558.6	12.9	Cu
	4537.6	[12.4	Wf	4559.6	13.8	B
	4538.5	[12.4	Pt	4559.7	13.5	Cu
	4538.6	[12.4	Cy	4560.6	14.1	B
	4539.5	[11.0	Pt	4562.9	[12.6	Pt
	4540.5	[12.4	Pt	4563.5	[12.6	Pt
	4541.5	[12.4	Pt	4563.6	[13.3	Ie
	4544.5	[11.0	Pt	4563.7	[13.0	Cy
	4544.5	[13.0	Cy	4563.7	[13.5	B
	4545.5	[12.4	Pt	4570.6	[13.7	Cu
	4546.5	[12.6	Pt	4571.7	[13.7	Cu
061647 V AURIGAE—						
	4554.7	12.1	Cu	4555.5	11.7	B

VARIABLE STAR OBSERVATIONS RECEIVED DURING FEBRUARY, 1926—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
061702 V MONOCEROTIS—						
	4532.1	8.2	Ch	4558.7	8.5	Cu
	4557.6	8.2	Pt			
063308 R MONOCEROTIS—						
	4552.6	11.8	B	4557.6	10.5	Pt
063462 NOVA PICTORIS—						
	4488.1	4.6	Bl	4498.0	4.6	Bl
	4489.0	4.6	Bl	4499.0	4.6	Bl
	4490.0	4.6	Bl	4505.1	4.6	Bl
	4493.0	4.6	Bl	4523.4	4.8	Sm
	4497.0	4.6	Bl	4533.3	4.8	Sm
063558 S LYNCIS—						
	4557.6	13.6	Pt			
064030 X GEMINORUM—						
	4552.6	9.8	B			
064707 W MONOCEROTIS—						
	4552.6	9.4	B	4557.6	12.3	Pt
065111 Y MONOCEROTIS—						
	4532.1	10.9	Ch	4557.6	12.3	Pt
	4552.6	12.2	B	4557.6	12.6	Bi
	4553.6	12.7	Lv	4560.7	12.7	Lv
065208 X GEMINORUM—						
	4524.3	7.7	L	4541.4	6.9	L
	4532.2	7.2	Ch			
065355 R LYNCIS—						
	4535.7	12.8	Wf			
070109 V CANIS MINORIS—						
	4532.1	[11.7	Ch	4551.6	13.7	B
070122a R GEMINORUM—						
	4524.1	7.4	Ch	4535.7	7.6	Wf
	4529.1	7.4	Ch	4557.6	8.1	Pt
	4534.1	7.7	Ch	4557.7	8.6	Sg
070122b Z GEMINORUM—						
	4557.6	12.4	Pt			
070122c TW GEMINORUM—						
	4557.6	8.1	Pt			
070310 R CANIS MINORIS—						
	4524.3	8.4	L	4552.8	9 6	Cu
	4534.6	9.0	B	4554.7	9.6	Cu
070772 R VOLANTIS—						
	4523.3	12.6	Sm	4529.3	11.8	Sm
071201 RR MONOCEROTIS—						
	4530.2	9.8	Ch	4558.7	11.2	Cu
	4553.7	11.0	Lv			
071713 V GEMINORUM—						
	4534 6	8.9	B	4552.5	8.9	B
	4535.5	8.9	Ie	4557.7	8.8	Pt
072708 S CANIS MINORIS—						
	4524.1	8.6	Ch	4554.6	7.6	Cy
	4524.3	8.4	L	4554.6	7.6	Jo
	4529.1	8.4	Ch	4557.7	7.3	Pt
	4534.1	7 9	Ch	4559.6	7.9	Cy
	4534.6	7.8	B	4559.6	7.9	Pc
	4551.6	6.9	B	4563.7	7.6	Cy
072811 T CANIS MINORIS—						
	4550.6	14.2	B			
073173 S VOLANTIS—						
	4497.0	11.7	Bl			
073508 U CANIS MINORIS—						
	4524.3	10.5	L	4550.6	9.7	B
	4532.6	9.8	B	4557.7	9.3	Pt
073723 S GEMINORUM—						
	4524.1	9.8	Ch	4534.1	9.4	Ch
	4529.1	9.6	Ch	4535.0	9.5	Ch
	4531.2	9.6	Ch	4550.6	9.6	B
	4532.6	9.7	B	4557.7	10.0	Pt
074241 W PUPPIS—						
	4497.0	7.9	Bl	4531.3	11.4	Sm
	4521.4	9.9	Sm	4547.3	12.6	Sm
	4526.3	10.8	Sm			
074323 T GEMINORUM—						
	4524.1	9.0	Ch	4535.0	9.0	Ch
	4529.1	9.0	Ch	4535.5	8.8	B
	4531.2	9.0	Ch	4557.7	8.8	Pt
	4534.1	9.0	Ch			
074922 U GEMINORUM—						
	4520.2	[11.4	Ch	4550.6	14.0	B
	4524.1	[11.7	Ch	4552.6	[13.3	Ie
	4525.3	14.1	L	4553.7	14.2	Wf
	4526.1	[12.4	Ch	4554.7	14.0	Cu
	4529.1	[12.3	Ch	4555.6	14.0	B
	4530.2	[12.3	Ch	4555.7	13.8	Cu
	4531.2	[12.3	Ch	4556.6	14.0	B
	4532.6	[13.7	B	4557.7	[12.4	Pt
	4533.2	[12.4	Ch	4558.5	[13.7	Ie
	4534.6	14.2	Wf	4558.6	13.9	B
	4535.7	[13.3	Wf	4559.7	[13.7	Cu
	4536.6	[13.3	Cy	4560.6	14.0	B
	4538.6	[12.4	Cy	4562.9	[13.3	Pt
	4539.6	[12.4	Cy	4563.6	[13.7	B
	4545.5	[11.8	Pt	4563.7	[13.3	Cy
	4546.5	[12.4	Pt	4571.7	[13.0	Cu
	4548.6	14.0	B			
075612 U PUPPIS—						
	4530.2	11.7	Ch	4558.7	11.6	Cu
	4548.6	11.2	B			
081112 R CANCRI—						
	4520 2	9.9	Ch	4552.6	8.7	Ie
	4524.3	10.0	L	4552.6	9.7	B
	4534.1	9.8	Ch	4557.7	8.6	Pt
	4535.5	9.8	B	4563.7	8.7	Cy
081617 V CANCRI—						
	4520.1	11.0	Ch	4552.6	12.4	B
	4529.2	11 2	Ch	4558.6	12.4	Pt
	4534.6	11.7	B	4563.7	12.0	Cy
082405 RT HYDRAE—						
	4536.6	8.1	B	4558.6	8.0	Pt
	4556.6	8.2	B			
082476 R CHAMAELEONTIS—						
	4499.0	[12.6	Bl	4533.3	[12.4	Sm
	4521.3	[12 4	Sm			
083019 U CANCRI—						
	4535.7	12.0	Wf	4552.6	13.2	Ie
	4536.6	11.7	Cy	4563.7	[12.4	Cy
	4550.6	13.0	B			
083350 X URSAE MAJORIS—						
	4535.6	9.4	B	4558.6	10.7	Pt
	4555.6	10.9	B			
084803 S HYDRAE—						
	4520.2	10.8	Ch	4558.6	12.6	Pt
085008 T HYDRAE—						
	4550.6	10.3	B			

VARIABLE STAR OBSERVATIONS RECEIVED DURING FEBRUARY, 1926—Continued.

Star	J.D.	Est.Obs.		J.D.	Est.Obs.	
085120 T CANCRI—						
	4520.2	9.4	Ch	4536.6	9.4	Cy
	4536.6	9.0	B	4558.6	8.5	Pt
090024 X PYXIDIS—						
	4554.8	10.0	Cu			
090151 V URSAE MAJORIS—						
	4532.6	10.4	B	4555.7	10.4	Cu
	4550.6	10.3	B	4558.6	10.5	Cu
	4552.7	10.7	Cu	4559.7	10.3	Cu
	4554.7	10.4	Cu	4570.6	10.4	Cu
090425 W CANCRI—						
	4535.7	12.3	Wf	4536.6	11.8	Cy
091868 RW CARINAE—						
	4499.0	12.3	Bl			
092551 Y VELORUM—						
	4497.0	11.2	Bl	4526.4	12.1	Sm
	4521.4	12.1	Sm	4533.3	12.4	Sm
092962 R CARINAE—						
	4497.0	7.1	Bl	4531.3	8.5	Sm
	4521.4	8.4	Sm	4547.3	9.0	Sm
	4526.3	8.5	Sm			
093014 X HYDRAE—						
	4526.2	8.0	Ch	4558.6	8.8	Pt
	4535.6	8.3	B	4563.6	9.4	B
093934 R LEONIS MINORIS—						
	4529.2	10.7	Ch	4536.6	10.0	B
	4531.2	10.4	Ch	4558.6	9.8	Pt
	4533.2	10.2	Ch	4563.6	9.7	B
	4535.2	10.2	Ch			
094211 R LEONIS—						
	4520.2	8.1	Ch	4552.6	6.5	B
	4529.2	7.5	Ch	4554.6	6.0	Jo
	4533.2	6.7	Ch	4558.6	5.4	Pt
	4535.2	6.0	Ch	4559.6	6.1	Pc
094512 X LEONIS—						
	4552.8	[12.3	Cu	4559.7	[12.3	Cu
	4554.8	13.1	Cu	4570.7	12.2	Cu
	4555.8	13.1	Cu	4571.7	12.2	Cu
	4558.7	[12.3	Cu			
094622 Y HYDRAE—						
	4558.6	6.5	Pt			
094953 Z VELORUM—						
	4499.0	12.6	Bl	4526.4	12.4	Sm
	4521.4	12.5	Sm	4531.3	12.1	Sm
095421 V LEONIS—						
	4550.6	[13.5	B	4558.6	13.5	Pt
095563 RV CARINAE—						
	4499.0	[13.1	Bl			
100661 S CARINAE—						
	4497.0	6.4	Bl	4531.3	8.0	Sm
	4521.3	7.5	Sm	4547.3	8.0	Sm
	4526.3	8.0	Sm			
100860 U URSAE MAJORIS—						
	4526.2	6.4	Ch			
101058 Z CARINAE—						
	4497.0	11.7	Bl	4527.3	[12.3	Sm
	4521.4	[12.3	Sm			
101153 W VELORUM—						
	4497.0	9.1	Bl	4533.3	9.8	Sm
	4521.4	9.6	Sm	4547.3	10.2	Sm
	4527.3	9.8	Sm			
103212 U HYDRAE—						
	4530.2	5.4	Ch	4536.7	5.0	L
103769 R URSAE MAJORIS—						
	4504.1	8.8	Wf	4555.6	11.3	B
	4526.2	10.0	Ch	4558.6	11.4	Pt
	4532.2	10.5	Ch			
104620 V HYDRAE—						
	4530.2	11.3	Ch	4536.7	10.6	L
	4533.5	10.8	Ch	4558.6	10.5	Pt
104814 W LEONIS—						
	4532.2	[11.2	Ch	4552.6	[13.4	B
110361 RS CARINAE—						
	4521.4	[12.3	Sm	4547.3	[12.3	Sm
	4526.4	[12.3	Sm			
110506 S LEONIS—						
	4532.2	[11.8	Ch			
111561 RY CARINAE—						
	4497.0	11.9	Bl			
111661 RS CENTAURI—						
	4497.0	10.7	Bl	4531.3	8.6	Sm
	4521.4	9.1	Sm	4547.3	8.6	Sm
	4526.4	8.6	Sm			
115058 W CENTAURI—						
	4497.0	10.8	Bl			
115919 R COMAE—						
	4532.2	[11.8	Ch	4554.9	13.3	Cu
120012 SU VIRGINIS—						
	4532.2	12.1	Ch	4558.6	9.4	Pt
121418 R CORVI—						
	4536.7	12.7	L	4558.6	13.3	Pt
122001 SS VIRGINIS—						
	4541.7	7.4	L			
123532 T CANUM VENATICORUM—						
	4558.6	11.0	Pt			
123160 T URSAE MAJORIS—						
	4504.1	13.1	Wf	4557.7	9.8	Gb
	4555.6	10.1	Ie	4558.8	9.5	Pt
	4555.7	10.2	Sg	4565.6	9.0	Pc
123307 R VIRGINIS—						
	4541.7	6.8	L	4562.8	8.5	Gb
	4558.8	8.7	Pt			
123459 RS URSAE MAJORIS—						
	4526.2	9.5	Ch	4555.7	11.5	Sg
	4535.6	10.0	Cy	4558.8	12.1	Pt
	4555.6	11.2	Ie	4563.8	11.4	Cy
123961 S URSAE MAJORIS—						
	4504.1	8.3	Wf	4558.7	10.0	Sg
	4524.3	8.3	L	4563.1	9.9	Cy
	4526.2	8.4	Ch	4565.6	10.1	Cy
	4555.7	10.0	Sg			
124204 RU VIRGINIS—						
	4562.9	12.5	Pt			
124606 U VIRGINIS—						
	4562.9	11.3	Pt			
131283 Y OCTANTIS—						
	4499.0	13.4	Bl	4526.3	12.4	Sm
	4521.4	12.2	Sm	4533.3	11.5	Sm
132422 R HYDRAE—						
	4533.5	9.2	Ch	4562.9	8.2	Pt
	4536.6	9.3	L			

VARIABLE STAR OBSERVATIONS RECEIVED DURING FEBRUARY, 1926—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
132706 S VIRGINIS—						
	4533.5	11.1	Ch	4562.9	9.8	Pt
134440 R CANUM VENATICORUM—						
	4530.3	9.1	Ch	4563.6	10.3	Ie
	4562.9	10.0	Pt			
134677 T APODIS—						
	4499.0	[13.2	Bl	4533.3	[12.7	Sm
	4523.3	[12.7	Sm			
135908 RR VIRGINIS—						
	4562.9	13.5	Pt			
140512 Z VIRGINIS—						
	4562.9	13.7	Pt			
141567 U URSAE MINORIS—						
	4557.7	8.3	Gb	4562.9	9.0	Pt
141954 S BOOTIS—						
	4504.1	13.6	Wf	4562.9	12.0	Pt
	4555.6	12.5	Ie			
142539 V BOOTIS—						
	4536.7	8.1	L	4563.8	9.8	Cy
	4562.9	8.9	Pt			
142584 R CAMELOPARDALIS—						
	4504.1	10.8	Wf			
143227 R BOOTIS—						
	4562.9	10.2	Pt			
144918 U BOOTIS—						
	4554.8	11.1	Cu			
145971 S APODIS—						
	4497.0	10.0	Bl			
150018 RT LIBRAE—						
	4562.9	12.8	Pt			
150605 Y LIBRAE—						
	4536.7	12.0	L	4562.9	11.8	Pt
151520 S LIBRAE—						
	4536.7	8.6	L	4562.9	8.8	Pt
151714 S SERPENTIS—						
	4536.7	12.4	L			
151731 S CORONAE BOREALIS—						
	4533.5	7.7	Ch	4562.9	8.7	Pt
	4562.8	9 3	Gb			
151822 RS LIBRAE—						
	4536.7	8.8	L			
152714 RU LIBRAE—						
	4536.7	10.2	L	4562.9	11.3	Pt
153378 S URSAE MINORIS—						
	4504.1	9.8	Wf	4562.9	8.6	Pt
	4561.7	8.3	Sg	4563.8	8.6	Cy
154428 R CORONAE BOREALIS—						
	4533.5	6.1	Ch	4555.1	6.0	Cy
	4535.5	6.1	Ch	4555.8	6.0	Cu
	4536.7	6.0	L	4558.8	6.1	Pt
	4538.9	6.1	Pt	4558.8	6.0	Cu
	4539.1	6.1	Cy	4559.1	6 0	Cy
	4540.1	6.0	Cy	4559.8	6.0	Cu
	4541.7	5.9	L	4562.8	6.0	Gb
	4544.1	6.0	Cy	4562.9	6.1	Pt
	4545.1	6.1	Cy	4563.1	6.0	Cy
	4546.9	6.2	Pt	4563.8	6.2	Cy
	4554.9	6.1	Cu	4563.9	6.1	Pt
154615 S SERPENTIS—						
	4533.5	7.0	Ch	4562.9	6.2	Pt
154639 V CORONAE BOREALIS—						
	4562.9	8.2	Pt			
155018 RR LIBRAE—						
	4562.9	12.8	Pt			
155823 RZ SCORPII—						
	4562.9	8.3	Pt			
160021 Z SCORPII—						
	4536.7	10.4	L			
160118 R HERCULIS—						
	4562.9	12.6	Pt			
160210 U SERPENTIS—						
	4562.9	12.0	Pt			
160325 SX HERCULIS—						
	4538.9	8.1	Pt	4562.9	7.9	Pt
	4541.7	8.0	L	4563.9	7.8	Pt
	4546 9	7.8	Pt			
160625 RU HERCULIS—						
	4541.7	10.2	L	4562.9	10.5	Pt
161122a R SCORPII—						
	4562.9	12.1	Pt			
161122b S SCORPII—						
	4562.9	12.2	Pt			
161607 W OPHIUCHI—						
	4541.7	13.0	L	4562.9	13.4	Pt
162112 V OPHIUCHI—						
	4562.9	8.0	Pt			
162119 U HERCULIS—						
	4535.5	[11.1	Ch	4562.9	13.1	Pt
162319 Y SCORPII—						
	4541.7	[13.0	L			
162807 SS HERCULIS—						
	4541.7	10.5	L	4562.9	12.1	Pt
162815 T OPHIUCHI—						
	4541.7	12.9	L	4562.9	13.5	Pt
162816 S OPHIUCHI—						
	4541.7	10.4	L			
163137 W HERCULIS—						
	4535.5	10.8	Ch	4562.9	8.6	Pt
163266 R DRACONIS—						
	4562.9	9.2	Pt			
164319 RR OPHIUCHI—						
	4562.9	11.7	Pt			
164715 S HERCULIS—						
	4562.9	8.2	Pt			
165202 SS OPHIUCHI—						
	4562.9	10.0	Pt			
165631 RV HERCULIS—						
	4562.9	14.3	Pt			
170215 R OPHIUCHI—						
	4562.9	8.5	Pt			
171401 Z OPHIUCHI—						
	4562.9	8.7	Pt			
171723 RS HERCULIS—						
	4562.9	10 0	Pt			
172486 S OCTANTIS—						
	4497.0	11.6	Bl	4523.3	12.4	Sm
	4504.0	11.8	Bl	4533.3	12.8	Sm
172809 RU OPHIUCHI—						
	4562.9	13.5	Pt			
173411 RT SERPENTIS—						
	4541.7	10.2	L			

VARIABLE STAR OBSERVATIONS RECEIVED DURING FEBRUARY, 1926—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
174406 RS OPHIUCHI—						
	4562.9	11.0	Pt			
175458a T DRACONIS—						
	4504.1	11.8	Wf			
175519 RY HERCULIS—						
	4535.5	[11.0	Ch	4562.9	12.2	Pt
180531 T HERCULIS—						
	4504.1	7.3	Wf	4535.5	8.3	Ch
	4523.2	7.6	L	4562.9	9.0	Pt
180565 W DRACONIS—						
	4562.9	9.1	Pt			
180911 NOVA OPHIUCHI, 1919—						
	4562.9	14.1	Pt			
181031 TV HERCULIS—						
	4523.2	9.8	L			
181103 RY OPHIUCHI—						
	4562.9	10.0	Pt			
181136 W LYRAE—						
	4504.1	12.0	Wf	4535.5	11.8	Wf
	4524.2	11.9	L	4562.9	9.5	Pt
182306 T SERPENTIS—						
	4526.9	11.5	Pt			
183149 SV DRACONIS—						
	4555.8	11.2	Cu			
183308 X OPHIUCHI—						
	4541.7	6.9	L	4562.9	8.0	Pt
183134 RY LYRAE—						
	4562.9	13.7	Pt			
184205 R SCUTI—						
	4347.0	6.1	H	4406.9	5.4	H
	4375.0	5.9	H	4536.7	5.3	L
	4376.0	5.9	H	4538.9	5.5	Pt
	4382.0	5.4	H	4562.9	5.5	Cy
	4383.0	5.6	H	4562.9	5.4	Pt
	4405.9	5.2	H	4563.9	5.3	Pt
184300 NOVA AQUILAE, 1918—						
	4562.9	10.8	Pt			
185634 Z LYRAE—						
	4562.9	13.5	Pt			
190108 R AQUILAE—						
	4562.9	7.9	Pt			
190926 X LYRAE—						
	4562.9	9.0	Pt			
190933a RS LYRAE—						
	4562.9	10.8	Pt			
190941 RU LYRAE—						
	4562.9	13.5	Pt			
190967a U DRACONIS—						
	4562.9	12.9	Pt			
191019 R SAGITTARII—						
	4562.9	6.8	Pt			
191033 RY SAGITTARII—						
	4497.0	6.5	Bl	4504.0	6.3	Bl
191350 TZ CYGNI—						
	4562.9	9.8	Pt			
191637 U LYRAE—						
	4562.9	10.6	Pt			
193311 RT AQUILAE—						
	4562.9	9.7	Pt			
193449 R CYGNI—						
	4529.0	9.1	Ch	4534.6	9.0	Wf
193509 RV AQUILAE—						
	4562.9	12.8	Pt			
193972 T PAVONIS—						
	4497.0	10.2	Bl	4526.3	8.0	Sm
	4504.0	9.5	Bl	4531.3	8.0	Sm
	4521.3	8.3	Sm			
194048 RT CYGNI—						
	4529.0	[10.0	Ch			
194348 TU CYGNI—						
	4529.0	[10.7	Ch			
194604 X AQUILAE—						
	4504.1	9.7	Wf	4562.9	11.0	Pt
194632 χ CYGNI—						
	4504.1	6.5	Wf	4526.0	4.8	Ch
	4523.2	5.4	Pe	4526.2	5.1	Pe
	4524.2	5.4	Pe	4531.0	4.5	Ch
	4525.2	5.2	Pe	4562.9	4.0	Pt
194929 RR SAGITTARII—						
	4497.0	9.6	Bl	4504.0	10.0	Bl
195142 RU SAGITTARII—						
	4497.0	12.1	Bl			
195553 NOVA CYGNI, 1920—						
	4546.5	12.5	Pt	4562.9	12.7	Pt
	4557.5	12.6	Pt			
195849 Z CYGNI—						
	4529.0	8.3	Ch	4557.5	9.1	Pt
	4535.5	8.6	Wf			
195855 S TELESCOPII—						
	4499.0	[12.6	Bl			
200212 SY AQUILAE—						
	4523.3	8.6	L	4562.9	9.0	Pt
200357 S CYGNI—						
	4530.0	[11.4	Ch	4534.6	[14.7	Wf
200715a S AQUILAE—						
	4535.5	11.1	Wf	4562.9	10.2	Pt
200715b RW AQUILAE—						
	4562.9	9.1	Pt			
200747 R TELESCOPII—						
	4499.0	[12.4	Bl			
200822 W CAPRICORNI—						
	4499.0	[11.6	Bl			
200938 RS CYGNI—						
	4516.0	8.9	Ch	4533.0	8.2	Ch
	4523.2	7.9	L	4535.0	7.8	Ch
	4525.0	9.0	Ch	4536.5	8.3	Cy
	4529.0	9.0	Ch	4539.5	8.2	Cy
	4530.0	8.9	Ch	4557.5	7.4	Pt
	4531.0	8.8	Ch	4563.1	7.6	Cy
	4532.0	8.4	Ch			
201008 R DELPHINI—						
	4524.2	12.8	L	4562.9	13.5	Pt
201139 RT SAGITTARII—						
	4499.0	[12.7	Bl			
201437b WX CYGNI—						
	4525.0	10.7	Ch	4539.5	10.8	Cy
	4529.0	10.8	Ch	4557.9	10.8	Pt
	4536.5	10.7	Cy			
201647 U CYGNI—						
	4529.0	8.0	Ch	4535.0	7.8	Ch
	4533.0	7.9	Ch	4557.9	7.9	Pt

VARIABLE STAR OBSERVATIONS RECEIVED DURING FEBRUARY, 1926—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
202240 U MICROSCOPII—						
	4497.0	8.9	Bl	4504.0	9.0	Bl
202946 SZ CYGNI—						
	4538.5	9.0	Pt	4545.5	9.4	Pt
	4539.5	9.0	Pt	4546.5	9.3	Pt
	4540.5	8.8	Pt	4557.5	8.8	Pt
	4541.5	8.8	Pt	4562.9	9.6	Pt
	4544.5	9.2	Pt	4563.5	9.8	Pt
202954 ST CYGNI—						
	4557.5	12.5	Pt			
203226 V VULPECULAE—						
	4546.5	8.8	Pt			
203429 R MICROSCOPII—						
	4497.0	11.6	Bl			
203847 V CYGNI—						
	4525.0	9.7	Ch	4533.0	9.0	Ch
	4529.0	9.3	Ch	4535.0	9.0	Ch
	4530.0	9.2	Ch	4535.5	8.6	Wf
	4532.0	9.2	Ch	4557.5	8.1	Pt
204016 T DELPHINI—						
	4520.0	[10.9	Ch			
204215 U CAPRICORNI—						
	4499.0	[11.5	Bl			
204846 RZ CYGNI—						
	4557.5	12.3	Pt			
204954 S INDI—						
	4499.0	[13.5	Bl			
205923a R VULPECULAE—						
	4530.0	8.8	Ch	4546.5	7.7	Pe
	4535.5	7.9	Wf			
210124 V CAPRICORNI—						
	4499.0	[12.5	Bl			
210221 X CAPRICORNI—						
	4499.0	[12.7	Bl			
210382 X CEPHEI—						
	4558.7	10.1	Cu			
210504 RS AQUILAE—						
	4524.2	10.8	L			
210868 T CEPHEI—						
	4408.0	7.7	H	4536.6	10.3	Cy
	4524.2	10.1	L	4557.5	9.7	Pt
	4529.0	10.3	Ch	4557.6	10.0	Mb
	4535.0	10.4	Ch			
211614 X PEGASI—						
	4535.5	9.8	Wf	4546.5	9.3	Pt
211615 T CAPRICORNI—						
	4497.0	12.2	Bl			
212030 S MICROSCOPII—						
	4499.0	[12.8	Bl			
212814 Y CAPRICORNI—						
	4497.0	[12.6	Bl			
213678 S CEPHEI—						
	4536.6	9.9	Cy	4558.5	9.6	Cy
	4557.5	8.3	Pt			
213753 RU CYGNI—						
	4525.0	9.6	Ch	4557.5	7.9	Pt
	4536.5	9.0	Cy	4558.5	8.0	Cy
	4552.6	8.3	Cy	4563.5	8.0	Cy
213843 SS CYGNI—						
	4504.1	11.9	Wf	4540.5	9.2	Pt
	4519.1	[10.0	Ch	4541.5	9.6	Pt
	4522.2	11.8	L	4541.5	9.5	Cy
	4524.2	9.5	L	4541.7	9.8	L
	4525.0	9.5	Ch	4544.5	10.5	Cy
	4525.3	9.7	L	4544.5	10.9	Pt
	4526.0	9.2	Ch	4545.5	11.2	Pt
	4529.1	8.6	Ch	4546.5	11.6	Pt
	4531.0	8.6	Ch	4548.5	11.5	B
	4532.0	8.6	Ch	4551.5	11.6	B
	4533.0	8.7	Ch	4552.5	11.8	Cy
	4533.5	8.0	Wf	4552.5	11.6	Ie
	4534.5	8.6	B	4554.5	11.5	Cu
	4534.6	8.3	Wf	4555.5	11.7	Ie
	4535.0	8.6	Ch	4557.5	11.7	Pt
	4535.5	8.4	Ie	4558.5	12.0	Cu
	4535.5	8.5	Wf	4558.5	11.7	Ie
	4535.5	8.3	Cy	4558.5	11.8	Cy
	4535.5	8.6	B	4562.9	11.8	Pt
	4536.3	8.5	L	4563.5	11.6	Ie
	4536.5	8.7	Cy	4563.5	11.8	Pt
	4538.5	9.0	Cy	4563.5	11.6	Cy
	4538.5	9.0	Pt	4563.6	11.6	Cy
	4539.5	9.0	Pt	4567.5	11.3	Cu
	4539.5	9.2	Cy	4570.5	11.6	Cu
213937 RV CYGNI—						
	4557.5	6.6	Pt			
214058 W CEPHEI—						
	4374.0	4.3	H	4401.0	4.2	H
	4375.0	4.2	H	4405.9	4.1	H
	4376.0	4.2	H	4542.9	4.1	H
	4378.0	4.2	H	4543.9	4.1	H
	4382.0	4.3	H	4544.9	4.1	H
	4383.0	4.2	H			
214247 R GRUIS—						
	4499.0	12.8	Bl	4521.3	[12.9	Sm
215863 U CEPHEI—						
	4370.0	5.3	H	4383.0	5.3	H
	4373.9	5.3	H	4408.0	5.3	H
	4375.0	5.3	H	4525.0	5.3	H
	4376.0	5.3	H	4542.9	5.3	H
	4378.0	5.3	H	4543.9	5.3	H
	4382.0	5.3	H	4544.9	5.3	H
220133a RY PEGASI—						
	4557.5	11.4	Pt			
220412 T PEGASI—						
	4530.1	11.7	Ch			
221938 T GRUIS—						
	4521.3	10.6	Sm	4526.3	10.5	Sm
221948 S GRUIS—						
	4521.3	9.6	Sm	4531.3	8.6	Sm
	4526.3	8.8	Sm	4547.3	7.8	Sm
222129 RV PEGASI—						
	4548.5	11.0	B			
222439 S LACERTAE—						
	4531.1	[10.4	Ch	4558.5	12.4	Ie
	4557.5	12.5	Pt	4563.6	[11.6	Cy
222867 R INDI—						
	4497.0	8.5	Bl	4504.0	8.7	Bl

VARIABLE STAR OBSERVATIONS RECEIVED DURING FEBRUARY, 1926—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
223462 T TUCANAE—						
	4523.3	[12.8	Sm	4547.3	[12.3	Sm
	4529.3	13.0	Sm			
223841 R LACERTAE—						
	4530.1	[10.4	Ch			
225914 RW PEGASI—						
	4452.5	[13.2	B			
230110 R PEGASI—						
	4531.1	[11.8	Ch	4557.5	11.5	Pt
230759 V CASSIOPEIAE—						
	4535.6	11.1	Cy	4557.5	12.0	Pt
	4539.5	11.4	Cy	4558.5	11.8	Cy
	4550.5	11.8	B	4563.6	11.9	Cy
	4552.5	11.7	Cy			
231425 W PEGASI—						
	4531.1	9.4	Ch			
231508 S PEGASI—						
	4531.1	8.6	Ch	4534.6	9.1	B
231878 RY CEPHEI—						
	4531.0	9.6	Ch			
232746 V PHOENICIS—						
	4521.3	[12.7	Sm	4525.4	[13.2	Sm
232848 Z ANDROMEDAE—						
	4531.1	9.0	Ch	4558.5	10.2	Cu
	4557.5	9.7	Pt	4570.6	10.1	Cu
233335 ST ANDROMEDAE—						
	4531.1	9.7	Ch	4557.5	10.3	Pt
	4534.5	9.8	B			
233815 R AQUARII—						
	4526.0	9.8	Ch			
233956 Z CASSIOPEIAE—						
	4535.6	12.5	Ie	4553.7	12.6	Wf
	4535.6	11.8	Cy	4558.6	12.9	Cy
	4550.5	12.5	B	4563.6	12.6	Cy
	4552.6	12.3	Cy	4563.6	12.5	Ie
235053 RR CASSIOPEIAE—						
	4531.2	[10.2	Ch	4563.5	11.2	Ie
	4548.5	11.3	B			
235209 V CETI—						
	4497.0	10.9	Bl	4523.2	12.1	L
	4504.0	11.2	Bl			
235265 R TUCANAE—						
	4521.4	[13.0	Sm			
235350 R CASSIOPEIAE—						
	4526.2	[11.4	Ch	4552.6	11.7	Cy
	4548.5	10.8	B			
235525 Z PEGASI—						
	4538.5	9.9	Cy	4563.6	10.8	Cy
	4557.7	11.0	Pt	4563.6	11.2	Ie
235855 Y CASSIOPEIAE—						
	4548.6	[13.4	B			
235939 SV ANDROMEDAE—						
	4534.5	8.0	B	4563.5	9.6	Ie
	4557.5	8.6	Pt	4563.6	9.3	Cy

Total observations, 1183; stars observed, 326; total observers, 20.

The following observers have contributed to this report of observations received during the month of February, 1926: Baldwin, "Bl"; Berman, "Bi"; Bouton, "B"; Chandra, "Ch"; Cilley, "Cy"; Cunningham, "Cu"; Gaebler, "Gb"; Hama, "H"; Iedema, "Ie"; Jones, "Jo"; Lacchini, "L"; Leavenworth, "Lv"; Macaughey, "Mc"; Murdoch, "Mb"; Peltier, "Pt"; Perrot, "Pe"; Proctor, "Pc"; Skaggs, "Sg"; Smith, "Sm"; Waterfield, "Wf".

LEON CAMPBELL, Recording Secretary.

March 11, 1926.

COMET NOTES.

Comet 1925 *I* (Ensor). — Ensor's comet did not prove the bright object that it was expected to be after perihelion, February 12. In fact at this writing no report has come of its having been seen at all since then. According to Professor Van Biesbroeck it seemed on March 15 to have vanished (see remark on page 228 of this issue of POPULAR ASTRONOMY).

This is partly explained by a note in the Copenhagen Circular 103, stating that Mr. Merfield had made an error of one day in giving the date of perihelion. It should have been Feb. 11.976 instead of Feb. 12.976. As the comet's motion was over 2° per day on March 15, the error of one day would throw the comet out of the field of the 24-inch reflector. A careful search was made on the night of March 27 by Professor Wilson with the 5-inch guiding telescope. Although the moon was nearly full, stars as faint as magnitude 10 were easily seen but no comet-like object was found.

The following revised ephemeris computed by Dr. A. C. D. Crommelin is given in Copenhagen Circular 104.

EPHEMERIS OF COMET 1925 *I* (ENSOR).

6h U. T.		α 1926.0 h m s	δ 1926.0 ° ′
April	1	1 19 32	+74 17
	5	2 48 24	+75 14
	9	4 05 07	+74 20
	13	5 01 54	+72 28
	17	5 41 38	+70 17
	21	6 10 27	+68 02
	25	6 32 16	+65 54
	29	6 49 28	+63 55

Comet 1925 *j* (Van Biesbroeck).— The following is part of an ephemeris of Van Biesbroeck's comet computed by A. Dubiago, as given in the Copenhagen Circular, No. 103.

EPHEMERIS OF COMET 1925*j* (VAN BIESBROECK).

0h U. T.		α 1926.0 h m s	δ 1926.0 ° ′
April	1	9 40 16	+3 20.7
	5	9 38 08	+2 50.2
	9	9 36 31	+2 21.0
	13	9 35 23	+1 53.0
	17	9 34 42	+1 25.9
	21	9 34 27	+0 59.6
	25	9 34 35	+0 33.9
	29	9 35 04	+0 08.8

Comet 1926 *b* (Blathwayt).—Blathwayt's comet has become very faint and is not likely to further interest amateurs. It is however in very good position for observation, being in the constellation Auriga a little northeast of Capella. The following ephemeris computed by Dr. A. C. D. Crommelin is given in the Copenhagen Circular 104.

EPHEMERIS OF COMET 1926 *b* (BLATHWAYT).

0h U. T.		α 1926.0 h m s	δ 1926.0 ° ′
April	1	5 14 19	+46 35
	5	5 13 48	+46 54
	9	5 13 51	+47 12
	13	5 14 28	+47 31
	17	5 15 30	+47 50
	21	5 17 02	+48 07
	25	5 18 49	+48 26
	29	5 20 52	+48 46

Comet 1925 *c* (Orkisz).—Observers are requested to publish or to send to Mr. Orkisz at the Cracow Observatory the observations of this comet. (*Acta Astronomica,* 1925 Dec. 8.)

Search Ephemerides for Finlay's Periodic Comet.— This comet will not be in very good position for observation this year, but may be found this spring with large telescopes. The following search ephemerides are given in the British Astronomical Association Handbook.

SEARCH EPHEMERIDES FOR FINLAY'S PERIODIC COMET.

	Perihelion June 19.0			Perihelion June 27.0		
0^h U.T.	α 1926.0	δ 1926.0		α 1926.0	δ 1926.0	Log Δ
	h m	° ′		h m	° ′	
April 8	21 59.5	—14 51		21 41.8	—16 25	0.258
16	22 29.0	—12 13		22 10.3	—14 03	0.234
24	22 59.5	— 9 14		22 40.0	—11 19	0.211
May 2	23 31.2	— 5 55		23 11.0	— 8 14	0.190
10	0 04.0	— 2 21		23 43.2	— 4 50	0.173
18	0 37.6	+ 1 23		0 16.6	— 1 11	0.159
26	1 11.9	+ 5 09		0 50.8	+ 2 36	0.150

Search Ephemeris for Kopff's Periodic Comet 1906 IV.—The following ephemeris computed by F. Kepinski of Warsaw, is given in the Copenhagen Circular 104.

EPHEMERIS OF KOPFF'S PERIODIC COMET.

0^h U. T.		α 1926.0	δ 1926.0
		h m s	° ′
April	3	22 30 57	—3 47.9
	7	22 39 54	—2 43.3
	11	22 48 42	—1 39.0
	15	22 57 19	—0 35.0
	19	23 05 46	+0 28.6
	23	23 14 03	+1 03.6
	27	23 22 10	+2 33.8
May	1	23 30 06	+3 35.2

The comet will be so deep in the evening twilight that it may not be visible at this apparition.

COMMUNICATIONS.

A Suggestion for Measuring the Speed of Meteors. — It is probable that the chief need of Meteoric Astronomy at the present time is some method of measuring the duration and true brightness of meteors as they cross the sky. Photography through a revolving sector is of little use, since it is rare to find a meteor that is sufficiently bright to be photographed. Although I have not the facilities here to try the experiment, it has occurred to me that these two quantities might be measured by means of a revolving mirror. This should be attached with its plane very nearly perpendicular to the shaft of a small electromotor, revolving let us say at 1800 revolutions. The motor is to be fixed with its shaft vertical, and the mirror nearly horizontal. On viewing the stars in the mirror, each will describe a small circle, and only the brighter stars will be visible. Should a meteor cross the field of view its light will not be materially diminished, but it will describe a wavy line, each wave corresponding to one revolution of the motor. The number of waves will then give the duration directly. By matching the brightness of the trail between two waves with the circles described by the stars, corrected of course for their diameters, the true brightness of the meteor, as distinguished from its apparent brightness in the sky, may at the same time be determined.

W. H. PICKERING.

Private Observatory, Mandeville, Jamaica, B. W. I., Feb. 27, 1926.

Handy Chart Illuminator and Holder for Variable Star Observers.—In the past, I have found it very difficult to secure the proper orientation of variable star charts under good illumination. After trying several crude and unsatisfactory dark lanterns, I constructed a chart holder and illuminator combined along the following lines:

I secured a piece of white pine board 24x15x¼ inches and sandpapered it smooth on one side. A piece of stiff copper tubing, about two feet long and one-fourth inch through, was bent in the shape of an L and the ends were flattened. Screw holes about one inch apart were drilled in the flattened ends and one end was bent at right angles to the tube, forming a supporting base. A block of wood 2x3x½ inches was sawed and a hole, just large enough to hold an old flashlight socket and reflector by friction, was bored in it. The block was then screwed to the copper tubing, the other end of the L was screwed to the board at one end and midway of the breadth. The tubing, which supported the light socket and reflector, thus overhung the board, with the reflector over the center of the board. Two ends of a four-foot piece of limp lamp cord were then soldered to the contacts of the light socket. A small one-way switch was screwed to one corner of the board, opposite the base of the lamp support. One side of the cord was connected through the switch. The lighting apparatus was completed by screwing a bulb in the socket and attaching a dry cell to the loose end of the cord. Two broad rubber bands were stretched across the breadth of the board.

In use, the battery may be set anywhere near the observer, while the illuminator is held in the lap. A chart is slipped under the rubber bands and turned at such an angle as to secure the correct orientation. I clip a notebook under the lower rubber band and use a pencil attached by string to my belt. When it is necessary to refer to a chart, the switch is closed and the light is directed onto the chart, and *nowhere else*. It was found advisable, however, to fasten a piece of red tissue paper over the reflector to cut down and diffuse the light.

The use of this illuminator reduces the time and energy required to refer to charts and make notes to a minimum, and all glare is eliminated along with the consequent desensitizing of the retina. It would be interesting to hear from other observers on this subject.

STERLING BUNCH.

Millsap, Texas, March 21, 1926.

Metric System of Weights and Measures.—I notice in your March issue (p. 221) a commendation of a bill introduced in Congress, to make 1935 the year when "the present system of weights and measures shall be replaced by the metric system," as the "standard system in all kinds of merchandising transactions." Since the metric system has already been legal for well over a century, it is to be assumed that this new bill proposes to make it mandatory.

Permit one who, as a mechanical engineer and scientist, has used both systems for nearly a half-century, to protest. The reasons are these:

The metric system is far from an ideal system. Where one has to do more computing than physical handling, it is preferable; wherefore all scientists use it. Where, on the other hand, more physical handling than computing has to be done, it is all but intolerable, from its clumsiness.

The sole basis of superiority in the metric system lies not at all in its decimal base, as is so commonly supposed, but in its having a *common* base for both numbers and measures.

The ideal base, for both numbers and measures, as has been proven by centuries of experience, in all lands, and as Herbert Spencer has ably exhibited, is,

first, the factor two, and then the factor three—whence four, six, eight, nine and twelve. In other words, the ideal base is not the decimal, but the *duodecimal*.

The thing to be done is not to coerce our weights and measures into the unnatural decimal system, just because our numbers happen to be in that unfortunate condition. If one is to be forced to meet the other, let the numbers be forced to change to the duodecimal system (which is far superior to the decimal, as a system of numbers), whereupon our present measures remain virtually unchanged. The new combined system would then be far superior, both in numbers and in measures, and in convenience of computation, to the present decimal or metric system.

In the *Transactions of the Am. Soc. Mech. Eng.*, Vol. 24, 1903, you will find a paper by the writer, setting forth in detail the advantages accruing from this only rational plan just advocated. If POPULAR ASTRONOMY is to take sides at all upon such a question, do let it be upon a really scientific and rational platform.

There is no danger, however, of any mandatory law being passed. The two systems have been in free and equal competition for over a century. In that competition the metric system has failed signally, for basic defects. Hence has arisen, time and again, czarist proposals to make its use mandatory. In every case the public sense of liberty and justice has co-operated with the public sense of the defects of the metric system, to defeat the plan. Today we are further from it, not nearer to it, than ever before.

SIDNEY A. REEVE.

St. Marks Apartments, Staten Island, New York, March 14, 1926.

The Shadow Bands during Totality. — I have just read with much interest, in POPULAR ASTRONOMY for March, Mr. Max Petersen's observations of shadow bands during the total phase of the eclipse of Jan. 24, 1925, which seem to bear out my son's observations of shadow bands at Beacon, N. Y., for some time after the beginning of totality. I wonder if there were not more observations of shadow bands during totality at this eclipse. I know of but one other, that of three engineers near Paterson, N. J., which was printed in the *Journal of the Royal Astronomical Society of Canada* for March-April, 1925.

In looking over some past records of eclipse observations I have come across several such observations. In the *Publications of the U. S. Naval Observatory*, Vol. X, Appendix, page B351, is the statement that the shadow bands appeared 31 seconds before second contact and lasted 14 seconds after it. This was at Daroca, Spain, Aug. 30, 1905. On page B183 of the same volume is a record of observations of the same eclipse made at Valencia, Spain. Here totality began at $13^h\,17^m\,15^s$. The last visibility of the corona occurred at $13^h\,22^m\,15^s$ and the disappearance of the shadow bands is recorded at $13^h\,19^m\,30^s$.

In *Publications of the U. S. Naval Observatory*, Vol. IV, Appendix I, one observer speaks of looking alternately at corona and shadow bands, another makes the significant statement that the shadows were not seen during totality but may have occurred and been missed as the observer's attention was taken up with the eclipse itself. How frequently in records of eclipse observations one reads that the shadow bands were still visible when the observer was called away to make other observations! Speaking for myself I can say that the shadow bands were completely forgotten during totality.

Terrestrial Magnetism for March, 1919, has a very interesting account of meteorological observations made by Prof. E. Waite Elder, head of the physical laboratory of East Side High School, Denver, Colo., at Corona, Colo., elevation 10,000 ft., during the total solar eclipse of June 8, 1918. I quote here the notes

opposite the time of mid-totality at Corona, G.M.T. $23^h\ 23^m$, "Had to use match to read thermometer. Too cloudy to see shadow bands at beginning of totality; shadow bands about 10 cm wide and 20 cm apart." An entry two minutes later reads: Brisk wind from N.W. at end of totality, shadow bands 15 degrees N. of E. traveling 2.5 to 3 m. per sec. toward S.E. by S. Would this not imply the visibility of shadow bands at mid-totality? It is also interesting to note here that although a brisk wind was behind the shadow bands they were hardly moving as fast as the shadow bands that we observed at Beacon, N. Y., last year, although there the air was absolutely calm. If the shadow bands are due to surface air currents why should their motion not be speeded up appreciably by a stiff wind?

Observations of shadow bands during totality have a very important bearing upon the question of the cause of shadow bands in general for if it can be proved beyond any question that shadow bands are seen—if only occasionally—during the total phase of the eclipse then the thin solar crescent immediately preceding and following totality must be eliminated as the source of light in the production of shadow bands and as the cause of their peculiar banded appearance. Eliminating the sun as the source of light in their production there is left only the general sky illumination, the corona or possibly light from conspicuous prominences. Also if the shadow bands are simply the shadows of surface air currents and can be seen occasionally during the darkness of total eclipse, one can think of many other occasions when they should be seen, for example daily around the time of sunrise and sunset when the glare of sunlight is sufficiently reduced. Is it not also true that all of the so-called shadow bands produced by search lights and other artificial means differ in some very important and essential details from the shadow bands that are associated with total solar eclipses?

The eclipse of June 29, 1927, visible in England, Norway and Sweden, may have many amateur observers and as professional astronomers feel they cannot spare the time from more important duties for the observation of shadow bands possibly some amateur observers may be found who will be willing to spare a few seconds during the total phase to look for shadow bands. Unfortunately the duration of the total phase of this eclipse in England is a matter of only a few seconds at best.

Isabel M. Lewis.

1921 Park Road N. W., Washington, D. C.

Review of Sunspot Observations Made at Alta, Iowa, during the Years 1924 and 1925.—The following sunspot observations are in continuation of those published in Popular Astronomy, XXXII, May, 1924, for the years 1921, 1922, and 1923. As noted in that communication, on 48 percent of the observing days of 1923 the sun's disc was spotless, during the year 1924 this had diminished to 39 percent and in 1925 to 9 percent. The actual minimum of the cycle seems to have been definitely passed about the middle of April, 1924, the longest no-spot period of 48 days was noted from December 28, 1923, to February 13, 1924, although other shorter quiescent periods were noted in February, April, and August, 1923.

1924.

The sun was observed on 68 days during the first four months of this year, 75 percent of them being spotless; after May 4 a long period of more or less spottedness consisting of some sporadic spots and other more permanent groups was noted until the close of the year. The month of December was so stormy and intensely cold that practically no observations were made.

1925.

There was a decided revival of activity this year, especially during and following the month of May when numerous disturbed areas of the disc began to assert themselves, and groups of spots became more frequent in both the north and south hemispheres. In September still greater activity with bright aurorae was noted, and during the closing months fine large spots and streams were visible.

The monthly summaries of the daily observations are given in the following table.

Months 1924	Number of Observing Days	Average Number of Groups	Average Number of Spots	Average Number of Faculae	Number of Spotless Days
January	15	0.0	0.0	0.8	15
February	18	0.5	3.4	0.7	11
March	14	0.2	0.6	0.5	11
April	21	0.4	6.1	0.8	14
May	13	1.5	7.1	2.0	3
June	13	1.3	7.8	1.4	0
July	13	2.3	10.5	1.8	0
August	16	1.5	5.6	1.7	0
September	17	2.3	11.3	2.1	0
October	19	2.3	9.6	2.3	0
November	10	1.8	17.3	2.6	3
December	3	0.6	6.3	3.0	1
1925					
January	14	0.9	3.8	2.0	5
February	8	1.7	6.1	3.0	1
March	15	1.1	7.8	2.1	2
April	14	3.0	10.8	2.5	0
May	13	2.8	16.7	2.2	0
June	10	4.5	22.9	3.4	0
July	2	3.0	14.5	3.0	0
August	6	2.3	11.7	2.8	1
September	6	4.3	26.3	3.8	0
October	7	4.6	26.0	4.7	0
November	11	3.2	20.1	3.9	0
December	9	6.2	40.6	4.2	0

DAVID E. HADDEN.

Astronomical Observatory, Alta, Iowa, March 10, 1926.

The Aurora and Magnetic Storm of 1926, January 26. – Two enormous sunspots, easily seen through a piece of dark glass, or dense photographic film, were observed near the sun's meridian on Saturday, January 23, and Sunday, January 24. Monday being cloudy, no observations were made; but on Tuesday, January 26, the sky cleared, showing the spots noticeably away from the meridian.

The magnetic disturbance reached its height on Tuesday, both the telegraph company and the telephone company reporting difficulty all day in getting messages through.

Local radio experts reported that evening one of the worst in their experience. The messages from even such a close and powerful station as WOC, Davenport, would fade to inaudibility. The trans-Atlantic wireless tests were then being conducted, and from newspaper reports, the trouble was general, being attributed to the aurora.

Two students, seniors, reported to the department the observation of an aurora. Mr. S. J. Lambert reported that the display was fading out when he noticed it, but as he had seen several aurorae when farther north he recognized

this one immediately. Mr. L. E. Benetier was in the outskirts of the city when he noticed the display, at about 7:30 P. M., January 26, 90th meridian time (1:30 A. M., January 27, Greenwich civil time). He reported that in the northwest, azimuth about 120 degrees, a single rather brilliant streamer, reddish purple in color, extended to an altitude of 25 or 30 degrees. In the north, azimuth perhaps 180 to 200 degrees, several less brilliant streamers extended about half way to the zenith. At 7:50 P. M. he was back in town and could not see the display. The city lights, and the moon nearly full, would hasten the disappearance.

Aurorae of this magnitude are unusual in this latitude at this time of year. This augurs well for a good display in March or April, or perhaps in early autumn of this year. The accurate observations of the radiant point made by some astronomers when the streamers extend south of the zenith might well be continued this season. Perhaps the altitude of some of the more unusual streamers and arches could be obtained by coöperative observing, sketching these features, and the brighter stars in this region on let us say the exact half hour of standard time.

C. C. WYLIE.

University of Iowa, February 8, 1926.

The Aurora and Magnetic Storm of February 23, 1926.— The large sun-spots presumably associated with the aurora and magnetic storm of January 26, reached on Tuesday, February 23, about the position of the previous disturbance, after a synodic rotation. The local manager of the Bell Telephone Company had kindly offered to notify me if the disturbance returned on Monday or Tuesday. At about 1:30 P. M. Standard Time on Tuesday, February 23, the call came, saying that the test boards at Davenport were showing fifty volts variation. This was not as severe as the January storm. The test boards were quiet again Wednesday morning.

With this warning from the telephone company, we were on the watch for an aurora that evening, and some radio fans were asked to test the reception. The radio was certainly not affected as in January. There was general agreement that the southern stations were coming in at least as well as usual, and that the reception from the eastern stations was O. K. Denver was reported as fading rather badly. Possibly the high altitude makes it more susceptible to cosmic influences. No one heard any northern stations. One reported definitely that he had tried for some without success.

The aurora was observed at times from about 7:55 to 9:10 P. M., Central standard time. It was watched from the outskirts of the city, away from artificial lights, and in spite of the moon being nearly full, the play of color, purple, pearly gray, and flaming rose, was very interesting.

The display was still quite conspicuous when, at a few minutes after nine, clouds came from the northwest, preventing further observation. The aurora was not visible at 7:00 P. M. and was easily seen at 7:55 when next looked for. The maximum altitude was about 30 degrees.

C. C. WYLIE.

University of Iowa, March 3, 1926.

The Magnetic Storm of March 5, 1926. — A large group of spots, easily seen through smoked glass or dense photographic film, was near the sun's meridian on Wednesday, March 3, 1926.

On the morning of Friday, March 5, 1926, the telephone company reported interference from earth currents. The interference started about 6 A. M. and

ceased shortly after noon, 90th meridian time. The voltage variation was probably 20 or 25, according to the local manager. This was less than that of the disturbance of February 23, which in turn was less than that of January 26.

Only one observer was testing the radio reception while the earth currents were flowing. He reported definitely that the reception, especially around 40 meters, was worse than he expected to find it Friday forenoon; and that it was noticeably better in the afternoon when the telephone company reported the trouble from earth currents had ceased.

Bad atmospheric conditions Friday evening made the results of radio tests somewhat uncertain and also prevented any attempt at observation of an auroral display. The sky was covered with clouds.

C. C. WYLIE.

University of Iowa, March 8, 1926.

GENERAL NOTES

Mr. F. S. Carrington of Washta, Iowa, died on February 6, 1926, at the age of 73 years. He was by profession a farmer, but was a lover of astronomy and had built and equipped an observatory of his own. He had been a subscriber to POPULAR ASTRONOMY for many years.

Mr. Clarendon Ions, an amateur astronomer now of Miami, Florida, and director of the Southern Cross Observatory located at Miami, has been honored by election as a Fellow of the Royal Astronomical Society of Great Britain.

The Southern Cross Observatory was founded four years ago by S. Lynn Rhorer, who set up his first telescope in Royal Palm Park, Miami, and invited the public to share with him the beauties of the sky. So great has been the interest that Mr. Rhorer has added a new telescope to the equipment each year.

Award of the Gold Medal of the Royal Danish Academy of Sciences to Mr. Harry Raymond and Dr. Ralph E. Wilson.— News was received Feb. 27, through the Associated Press, of the award of the Gold Medal of the Royal Danish Academy of Sciences to Mr. Harry Raymond and Dr. Ralph E. Wilson of the Department of Meridian Astrometry of the Carnegie Institution of Washington, located at the Dudley Observatory, Albany, N. Y.

This Gold Medal was offered in June, 1923, by the Danish Academy for the best solution of the following problem—an explanation of the difference in the direction of the sun's motion as derived from radial and proper-motions of the stars—the competition to be anonymous and closing on October 31, 1925.

The motion of the sun may be determined in two ways. First, it is evident that as the sun moves forward those stars directly in its path will seem to be approaching us. In reality, of course, we are approaching them, but as we are not conscious of our own motion the effect is an apparent motion of the stars towards us. Likewise the stars being left behind by the sun seem to be receding. The spectroscope affords us the means of measuring these speeds of approach and recession and so provides one method of determining the sun's motion.

Secondly, it is easy to see that, although the stars directly in the sun's path are apparently approaching us and those directly back of us are apparently receding from us, neither of them are displaced in their positions on the sky. But the stars situated at right angles to the sun's motion will seem to be drifting backward as the sun moves forward. The measurement of this apparent drift of the stars

affords a second method of determining the sun's motion.

Unfortunately these two methods have not agreed in giving the same direction for the sun's motion, and since many problems concerning our stellar universe depend upon a knowledge of the motion of the sun in space, the question of reconciling the results derived by the two methods became of some importance.

The successful paper demonstrated the existence of small systematic errors in the observations of the apparent drift of the stars. After applying corrections to take account of these errors, the solar motion was determined, using a list of identical stars for which both the radial and proper motions were known. As a result the discordance hitherto noted vanished.

The Eclipse Expeditions at Benkoelen, Sumatra.—Professor John A. Miller, who has just returned from Sumatra with the Swarthmore College eclipse expedition, has very kindly sent us the photograph which is reproduced as Plate VI, frontispiece to this issue of POPULAR ASTRONOMY. The following letter, dated March 15, accompanying the photograph will be of interest to our readers:

"We have just returned with the Swarthmore College eclipse expedition. In addition to our own expedition there were in Benkoelen the Harvard University expedition, the German-Dutch expedition, the English expedition, and the Australian expedition, also Captain Harris, of the United States Signal Reserve, who brought with him a battery of powerful motion picture cameras. There were thirty persons in the observing personnel of these expeditions.

"It was arranged, by the Dutch officials, that all of us should take our luncheon and dinner at the Oranje Hotel, and twice every day we gathered around a single long table. We came to be known as the International Eclipse Observers. It was a delightful company, and on the last day that we were there a photograph of it was made. I am enclosing this photograph with the names of the various people in it, thinking that you might care to use it.

"You will be glad, of course, that the weather proved propitious in Benkoelen, and it seems that the results obtained by the various expeditions are excellent.

"The United States Naval Observatory was situated at Kapaihang, about seventy-five kilometers distant, and there was a Dutch expedition located at Palembang, on the east coast of Sumatra."

Goodsell Observatory Fellowships. — Two fellowships in astronomy have just been provided at Goodsell Observatory of Carleton College. The stipends amount to $500 each annually, beginning September 1. Holders of fellowships may attend college classes without payment of tuition fees and will have half-time available for graduate study. These fellowships are open to properly qualified college graduates. Further information may be obtained by applying to Professor E. A. Fath.

The Solar Atmosphere. — In the *Scientific American* for January, 1926, Professor Henry Norris Russell, in his monthly astronomical article, after speaking of the expeditions to observe the solar eclipse in Sumatra on January 14, gives the following very interesting account of the extent of the solar atmosphere and its lack of density and pressure:

"From the existing observations, it appears that the sun's atmosphere is very extensive. The lower part, in whose spectrum practically all the bright lines are to be found, rises some two hundred miles above the photosphere. In the next few hundred miles most of the lines fade out, but the stronger ones, even of heavy metals like titanium and iron, rise to 800 or 1,000 miles. A few lines go

much higher, up to 4,000 miles, and a very few—belonging to hydrogen, helium, and calcium, rise to 8,000 miles, all around the sun, forming the chromosphere—and above this again to great altitudes in the prominences.

"These unquestioned facts raise many difficult problems. How much material is there in this great atmosphere of the sun? Why does it rise so high, in spite of the powerful force of gravity at the sun's surface, nearly twenty-eight times as great as on earth. Above all, why do heavy atoms like those of calcium rise as high as the far lighter ones of hydrogen and helium?

"First, as regards the quantity of gas in the solar atmosphere, the independent work of several investigators—Milne at Cambridge, Miss Payne at Harvard, and Stewart and the writer at Princeton—shows that the pressure and density must be very low.

"When the gas has a hundredth of the pressure—and, at its high temperature, less than a thousandth of the density—of ordinary air it must be rendered hazy by various processes involving the inter-action of electrons, atoms and light-waves, so that on the scale of solar phenomena, it would appear opaque and be part of the brilliant photosphere. Indeed, Milne's latest calculations indicate that this would happen at the density a hundred times lower still. The transparent atmosphere above this level must be of extreme tenuity. At the maximum, there can hardly be more gas above the photosphere than would make, if compressed, a layer as dense as air and ten feet thick. At the minimum, the thickness of the corresponding layer may be only an inch.

"A few feet or inches of air, then, expanded to form a layer hundreds of miles deep—this is the conception of the sun's atmosphere to which modern physics leads us.

"One may wonder how so thin an atmosphere can absorb the lines of the solar spectrum; but the outer vapors of an electric arc, charged (for example) with sodium, although but a fraction of an inch in thickness, can absorb the sodium lines more strongly than the sun's whole atmosphere does—as direct comparison shows. This, then, need not trouble us. But by what means is this minute amount of gas expanded into an atmosphere a thousand miles and more in depth? The very high temperature accounts for a good deal, but even more important is radiation pressure. The intense outgoing flood of light from the sun tends to drive along with it any obstacle. On a body as big as a pebble, this effect is insignificant, but on such a tiny thing as an atom, it may be great enough to balance even the sun's great force of gravity, if the atom absorbs even a small part of the sun's light.

"Above the lowest layer, in which all the lines are found (and perhaps to some degree in this layer too) radiation pressure must be the main factor in keeping the sun's atmosphere from settling down closer to the visible surface. The calcium atoms (which absorb the two strongest lines in the whole spectrum) must be exceptionally subject to this influence, and hence it is not surprising that they rise as high even as hydrogen."

Radio Talks on Astronomy.— Professor C. C. Wylie writes that they are giving radio talks once a month from the University of Iowa station WSUI, wave length 483.6 meters. The next talks are scheduled for April 5 and May 3, the first Mondays, at 12:30 P. M. The next talk will be on Easter, with a few remarks about the stars and planets for the month.

According to a bulletin from the Ohio State University, Dr. Menzel will give a series of short talks on "Atoms and the Stars" from station WEAO, wave length 293.9 meters, at 8:00 P. M. Wednesdays, June 2, 9, 16, 23.

Cloud Studies by Arthur W. Clayden, M. A., formerly Principal of University College, Exeter. Second Edition. Publishers, E. P. Dutton and Company, New York. Price $6.

This is a well written book of 200 pages, illustrated with 64 finely executed plates of cloud photographs. The author uses the common terms for describing the various types of cloud formation but finds that the variety of form is so great that it is necessary to add many new classifications. In selecting the names of the new classes he has, however, simply added qualifying terms to the old notation, so that one is not confused at all by the new nomenclature.

To the amateur student of cloud forms the book is invaluable and to the artist, as the author says in his introduction, the plates may be of use by calling attention to the variety and exquisite beauty of the sky. "Nothing is more extraordinary in art than the general neglect of cloud forms. Many of them are quite as worthy of careful drawing as the leaves of a tree, the flowers of a field, the ripples of a stream, or the texture of a carpet or a marble pavement. Yet it is the common rule to find pictures, which are otherwise marvelous examples of skill and care, disfigured by impossibly skies with vague, shapeless clouds, as untrue to nature as it would be possible to make them. Grace of outline, delicacy of detail and texture, richness of contrast, beauty of form and light and colour, all are present in the skies, and combine to make a whole well worthy of the best that art can give."

The author gives clear, definite and simple, instructions for the computation of the altitudes of clouds and description of methods and form of camera to be used in cloud photography.

The Earth and the Stars, by Charles G. Abbot, D. Sc., published by D. Van Nostrand Company, 8 Warren St., New York. 275 pages. Price $3.00.

This is a delightful book, written by the assistant secretary of the Smithsonian Institution, a master of experimental astronomy, in language simple enough to be understood by the average reader. In his preface the author says: "This book is for non-technical readers, and not for the professional astronomer." Yet we venture to say that the professional astronomer, picking up the book and opening it at random, will find the matter so fascinating that he will not lay it down until he has read page after page.

To those who wish to acquire by easy reading a general survey of the universe in which they dwell, this book will be extremely helpful and interesting.

Amateur Telescope Making. — Scientific American Publishing Co., 1926. Price $2.00. This book of 100 pages brings together just the information needed by the person who wants to try his hand at making a reflecting telescope. It is divided into six parts as follows: Part I by Russell W. Porter, Mirror making and mounting, A sun telescope, Literature and materials; Part II by the Rev. William F. A. Ellison, The Amateur's Telescope; Part III, Methods of Silvering; Part IV by Albert G. Ingalls, Miscellany; Part V by Clarendon Ions, Telescope mounting from automobile parts; Part VI by John M. Pierce, A telescope that anyone can make. Most of this material has been printed before in the *Scientific American, Popular Astronomy,* and elsewhere.

The book tells where to get all materials and gives prices; tells exactly how to go about the grinding, polishing, figuring and testing of a telescope mirror; how to silver it and how to mount it. The book is written in simple language; technical expressions are either avoided or carefully explained. Special efforts have been made to warn against possible mistakes as well as to give directions for

correcting them is made. By following the directions given, anyone who has a reasonable amount of mechanical ability and patience can make his own telescope. The book is fully illustrated and can be recommended most heartily, not only to those who desire to build a telescope for themselves, but also to the many who may wish to read about the methods to be used for their own information without necessarily undertaking the actual work.

The *Scientific American* has rendered a real service to astronomy by gathering this material and putting it in such a convenient form.

Stellar Atmospheres by Cecilia H. Payne. This book of over 200 pages is the first of a series of monographs which is being published by the Harvard Observatory. It is called "A contribution to the observational study of high temperature in the reversing layers of the stars." Its scope can be judged by the following chapter headings: 1. The laboratory basis of astrophysics. 2. The stellar temperature scale. 3. Pressures in stellar atmospheres. 4. The source and composition of the stellar spectrum. 5. Elements and compounds in stellar atmospheres. 6. The high-temperature absorption spectrum of a gas. 7. Critical discussion of ionization theory. 8. Observational material for the test of ionization theory. 9. The ionization temperature scale. 10. Effects of absolute magnitude upon the spectrum. 11. The astrophysical evaluation of physical constants. 12. Special problems in stellar atmospheres. 13. The relative abundance of the elements. 14. The meaning of stellar classification. 15. On the future of the problem.

The book brings together and discusses the results of the many papers published on the subject, gives hundreds of references to the original papers and presents the results of Miss Payne's elaborate study of the thousands of photographs of stellar spectra taken at the Harvard Observatory. Authorities may not agree fully with all of Miss Payne's conclusions but in such a comparatively new and complex subject this must be expected. The book will be of great value to all students of the stars and may be purchased from the Harvard Observatory for $2.50, which is less than the cost of production.

Announcement. — On April 1, 1926, the business of Harold M. Bennett will be transferred to Carl Zeiss, Inc., New York. The new firm will take over the assets and liabilities of the Harold M. Bennett business, and will continue with the same staff at the above address.

For our dealer customers there will be practically no other change than that of the name.

Carl Zeiss, Inc., will be the sole U. S. distributing agents for: Carl Zeiss, Jena; Ica A. G., Dresden; R. Winkel, G. m. b. H., Goettingen; Georg Wolf, G. m. b. H., Berlin.

HAROLD M. BENNETT.

A Correction. — On page 164 of POPULAR ASTRONOMY, March, 1926, line 4 from the end of the article, for $H\beta$ read $H\alpha$. Reference 12 on the same page refers to G. Udny Yule's book, "An Introduction to the Theory of Statistics."

The Irish night watchman at the observatory was new. He paused to watch a man peering through a large telescope. Just then a star fell.

"Man alive," he exclaimed with amazement, "You're shure a foine shot."— *Exchange.*

IN STARRY SKIES.

In starry skies, long years ago,
I found my Science. Heart aglow
I watched each night unfold a maze
Of mystic suns and worlds ablaze,
That spoke: "Know us and wiser grow."

And with each season's ebb and flow,
My soul, with faltering steps and slow,
Still wanders up far-glimmering ways
In starry skies.

Nor do I heed Life's gaudy show,
But onward, upward I shall go,
Until new star-lands meet my gaze,
And where, perhaps in after-days,
I'll learn the things I long to know
In starry skies.

STERLING BUNCH.

Route No. 3, Millsap, Texas. Feb. 1, 1926.

END THERE IS NONE.

Slipping its fetters the soul wings its flight,
Mounting the winds through the mysteries of night;
Riding through space in eternity's car,
Touching the moon and caressing each star!

Onward and upward, forever we go,
Star-clouds and clusters, above and below;
Planets encircling each radiant sun,
Worlds that are dying and worlds just begun!

Hark! 'Tis strange music, the music of spheres!
Music transcendent to mortal man's ears;
Galaxies, nebulae, sun upon sun,
Universe of God, Oh! End there is none!

LESLIE C. BEARD.

Hagerstown, Md., Feb. 8, 1926.

Astronomical Telegrams.—The following exchange of telegrams is understood to have passed between the young bachelor, who is director of an observatory recently under construction, and the superintendent of a quarry of Bedford stone. It should be explained that the frieze around the observatory is made up of a series of panels, repeating the signs of the Zodiac, including, of course, Aquarius and Virgo.

To Supt. of Quarry:
Have too many old men. Need a Virgin.
—Director.

To Director:
Keep old men. Am sending Virgin.
—Superintendent.

ASTRONOMICALLY CORRECT.

To one who trains a canine star I cried:
"Why don't you teach him comedy delicious?"
And to my foolish question he replied:
"The dog star, sir, at all times must be Sirius!"

—*American Legion Weekly.*